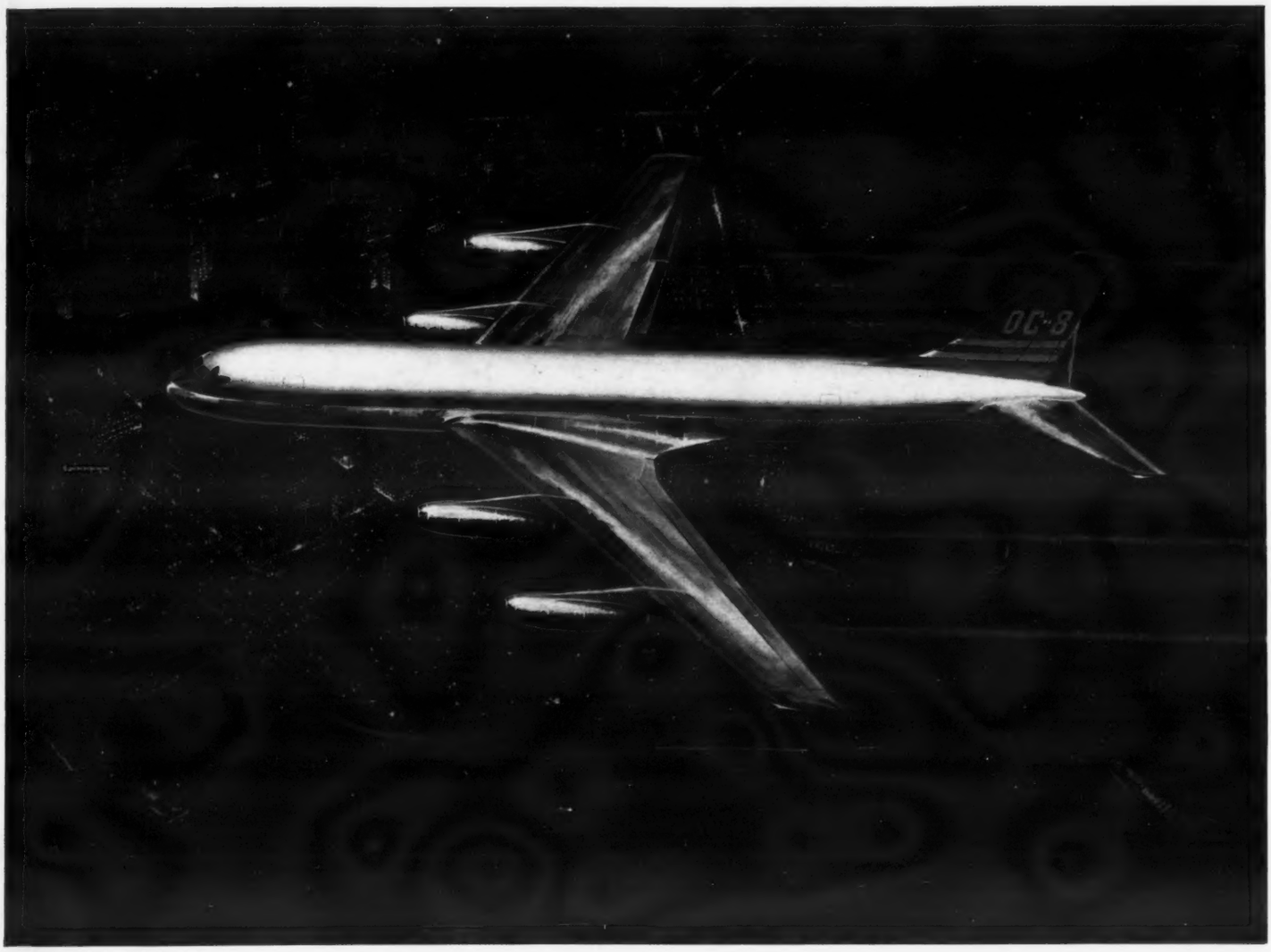
INTERAVIA

REVIEW OF WORLD AVIATION



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IN THIS ISSUE

Cooperation in Air Transport

New Medium-Range Airliners

VOLUME X **10** OCTOBER 1955

SAFE! ON ANY BASE
The high-winged C-123 Assault Transport is a perfect teammate to the twin-boomed C-119 Flying Boxcar.
Especially designed for safe, swift air-landing or paradropping of men and material at advanced bases, the C-123 brings new mobility to tactical air support under any conditions of climate or terrain.
Powered by Pratt and Whitney engines, this new assault transport is rugged and versatile. More than 22,000 pounds of howitzers or motorized equipment, 60 airborne troops with full field equipment, can be landed on improvised runways or dropped at front line positions — 50 litter cases can be evacuated from combat areas.
A new comrade-on-wings to the famed, combat-proven Flying Boxcar takes to the air — another outstanding Fairchild production achievement.
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Enlist to fly in the U.S. Air Force
"The future is measured in light-years"

INTERAVIA

Review of World Aviation

Volume X | No. 10 | October 1955

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Front cover :

Shape of things to come : an artist's impression of the Douglas DC-8 jet-liner flying over Manhatten.

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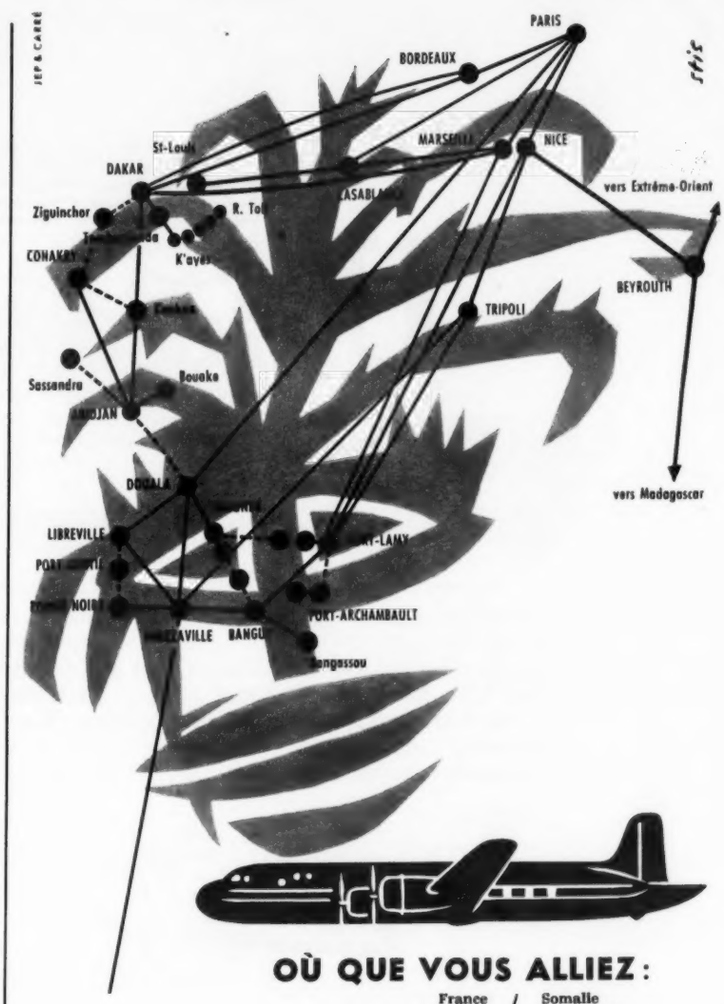

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Marruecos / Madagascar
Africa Occidental Francesa / Oriente Medio
Africa Ecuatorial Francesa / Extremo Oriente
Cameron / Johannesburgo

allí va también la U. A. T. con sus Super DC6 tan prestigiosos como confortables

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United Airgram

UNITED AIRCRAFT EXPORT CORPORATION

SIKORSKY HELICOPTERS RESCUE HUNDREDS IN FLOOD DISASTERS

Scores of military and civilian helicopters rescued hundreds of persons during recent disasterous floods in the United States. The majority of these aircraft were Sikorsky S-55 and S-58 types. An estimated 70 machines operated successfully under difficult flight conditions and at a time when no other kind of transportation could function for this purpose. Many flew from dawn to dusk during the two-day flood crisis in Connecticut, Pennsylvania, New York, Massachusetts, New Jersey and Rhode Island.

Fortunately there was a comparatively large number of helicopters available in the vicinity of the stricken areas.

The mass helicopter operations were carried out with aircraft loaned by all the U. S. military services, and by manufacturers located in the stricken areas.

Many were new helicopters awaiting delivery to the army or navy when the floods struck. One such group from Sikorsky Aircraft in Connecticut, including 11 new S-58 type helicopters, rescued a total of 475 persons.

The largest single rescue total, 249 people, was credited to a Navy pilot flying a Sikorsky HSS-1 helicopter.

Hundreds of other persons were taken from islands, rooftops, trees, piles of debris, or from the flood itself in similar helicopter operations in other states where the flash floods hit after torrential rains.

Behind the spectacular rescue total lies proof of dependability and adaptability of helicopters. Nearly every military version of two Sikorsky helicopter models was in service, often from makeshift bases. In addition to rescue work, helicopter duties included aerial photography and reconnaissance, air-lifting emergency electrical generators and other hospital equipment, flying food and water, medical supplies, carrying personnel and laying emergency telephone wire.

PRATT & WHITNEY AIRCRAFT TO BUILD BIG PLANT ADDITION

Pratt & Whitney Aircraft's plant at North Haven, Connecticut, will be doubled in size next year to provide more room for expanding jet engine production. The addition will add half a million square feet of manufacturing space, and 100,000 square feet of office area. The work is expected to be completed by June, 1956.

P&WA-POWERED F-100 TOPS 800 MPH; SETS WORLD RECORD

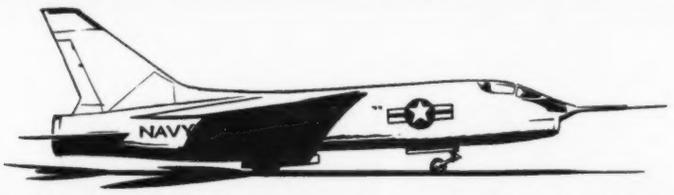
A new U. S. Air Force F-100C Super Sabre jet fighter has set a new world speed record over a measured course. Its average speed in both directions over the course was 822.135 mph.

The former world's speed mark of 755 mph was set in 1953 by an earlier model of the F-100, also powered by the J-57 engine. The F-100C Super Sabre was built by North American Aviation Company and powered by a Pratt & Whitney Aircraft J-57 turbojet engine.

The new record was the first ever timed in the faster-than-sound class. Colonel Horace A. Hanes, director of flight test at Edwards Air Force Base in California, flew the record breaking Super Sabre. The course was at Palmdale, on the edge of the California desert. The record flights were timed by the National Aeronautic Association using specially designed cameras and clocking equipment. The four passes were flown at approximately 35,000 feet altitude, where the speed of sound is 663 mph.

The big J-57 engine, now in its third year of quantity production, is in the 10,000-pound thrust class. In the F-100, its power is increased enormously by an afterburner.

HAMILTON STANDARD AIR CONDITIONING SYSTEM HANDLES NUMEROUS JOBS



The high-pressure, high-temperature air from the compressor of a turbojet engine is the basic source of power for a new air conditioning system designed by Hamilton Standard for high-speed combat aircraft such as Chance Vought's new XF8U-1 day fighter. The system will perform six to eight different functions simultaneously, although each is performed at different temperatures and pressures. These include defogging the windshield and providing cabin heat, or cabin cooling as needed; pressurizing the wing fuel tanks; pressurizing the pilot's anti-G suit, and providing air for the turn and bank gyro. Hot air is blasted across the outside of the windshield, eliminating the need for the usual mechanical wiper. Conditioned air is also furnished to the pilot's "space" suit, which is equipped with its own pressure regulator to function the instant cabin pressure drops. Cooling and pressurizing the aircraft's complex electronic equipment is still another function of the system.

The system represents a new high in the design and manufacture of vital aircraft accessory equipment, taking advantage of the light weight and high performance available with pneumatic systems. It utilizes Hamilton Standard-designed turbines, heat exchangers, pneumatic valves and control systems.

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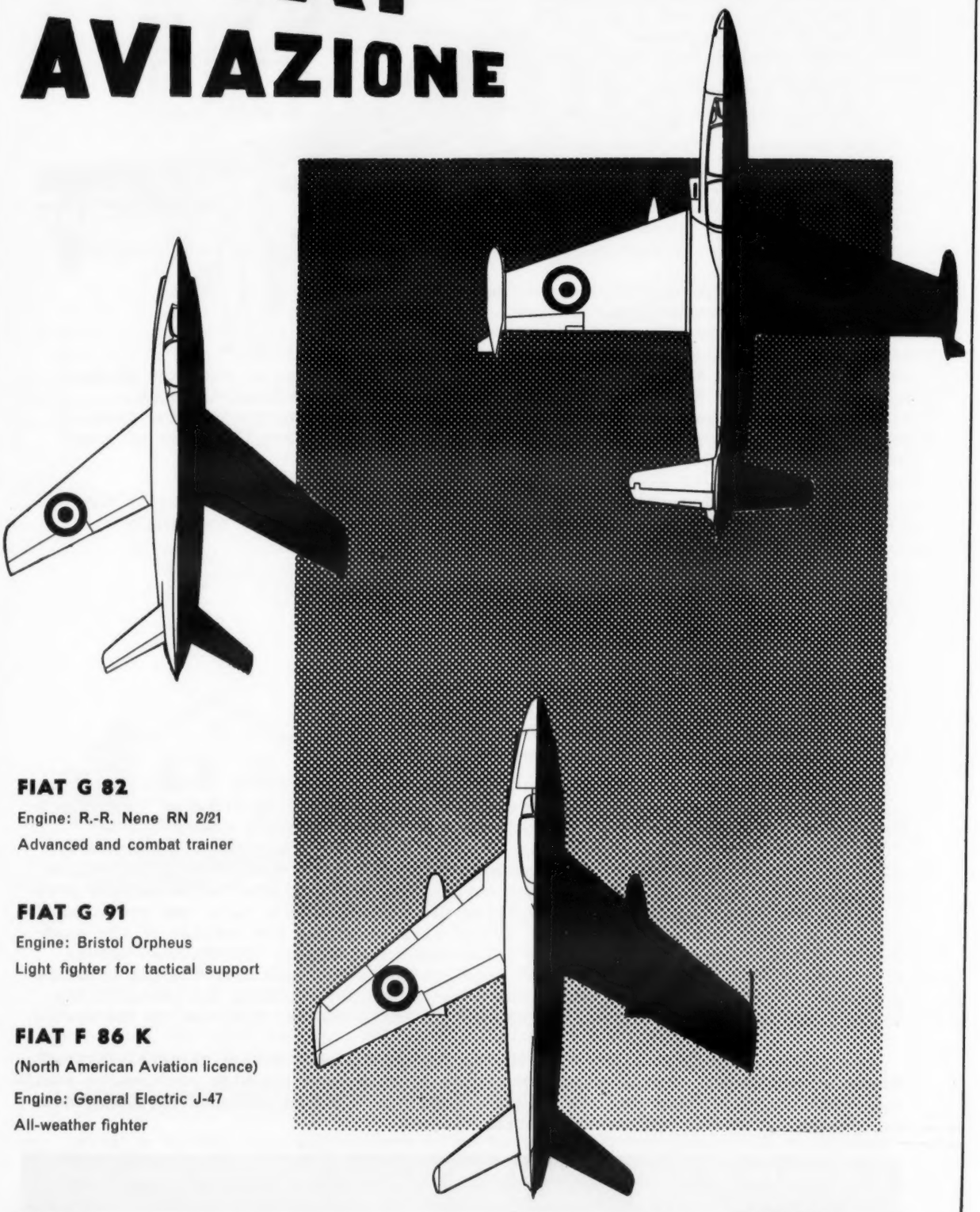
FIAT AVIAZIONE

FIAT's New Jet Aircraft



FIAT G 82
Engine: R.-R. Nene RN 2/21
Advanced and combat trainer

FIAT G 91
Engine: Bristol Orpheus
Light fighter for tactical support

FIAT F 86 K
(North American Aviation licence)
Engine: General Electric J-47
All-weather fighter

FIAT Divisione Aviazione – Corso G. Agnelli 200 **TURIN** (Italy)

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The LOCKHEED *Electra*

A completely new airliner,
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to the end of the graceful control
surfaces in the rear

This will be a history-making plane,
the first airliner to be
produced in the United States
powered with
modern turbo-prop engines.

AMERICAN AIRLINES

serving 77 cities
in the U.S.A.,
Canada and Mexico,
have placed
an initial order
for

35 Electras

SPEED — Cruising easily at well over 400 mph, the Lockheed «Electra» will have a speed advantage of 100 mph over the fastest turbo-prop airliner in commercial service today.

QUIET — The subdued hum of the turbine engines, with their relative freedom from vibration, coupled with modern techniques in sound proofing will provide a new atmosphere of quiet relaxation.

COMFORT — This airplane will introduce a newand heretofore unequaled standard of airline comfort: a spacious club-like lounge; wider, more comfortable reclining chairs; wide-view rectangular windows; air conditioning for maximum comfort in the air or on the ground; improved cabin pressurization to provide comfortable cruising at all altitudes up to 30,000 feet.

CONVENIENCE—The many innovations in passenger convenience will include: carry-on baggage facilities for those who prefer them; improved design for faster handling of checked baggage; built-in steps, eliminating the delay of «rolling up» a loading ramp; individual fixed tables at each seat for dining, reading or writing.

Lockheed AIRCRAFT CORPORATION
BURBANK, CALIFORNIA, USA

Look to Lockheed for Leadership.

TACTICAL AIR MOBILITY. Mobility of men and materiel is a vital problem in the new atomic era. So the U.S. Air Force needs a high-speed, low-slung combat cargo plane that can use even short, improvised runways. The new C-130 Hercules with turbo-prop power (Allison T-56 engines) will do this. Now in production at Lockheed's Georgia Division, Marietta, Georgia, U.S.A.

Lockheed's New Prop-Jet Carries More People, Cargo Farther, Faster, Cheaper

POWER RESEARCH. To prove how even advanced turbo-prop engines could be used on existing air frames designed for piston power, the U.S. Navy and Air Force selected Super Constellations (below). Result: these Super Constellations are the world's fastest propeller-driven airplanes, and are now flying for the U.S. armed forces. Lockheed is leading the industry in turbo-prop power. Look for the new Lockheed Electra commercial transport with this advanced power. Already ordered in quantity by American Airlines, this advanced airliner promises speeds up to 100 mph faster than commercial transports now in service, and amazing new operating economies for airlines. For travelers throughout the world, the Electra will provide quicker schedules, quieter comfort. Lockheed's vast experience in turbo-prop aircraft will make possible record production schedules.

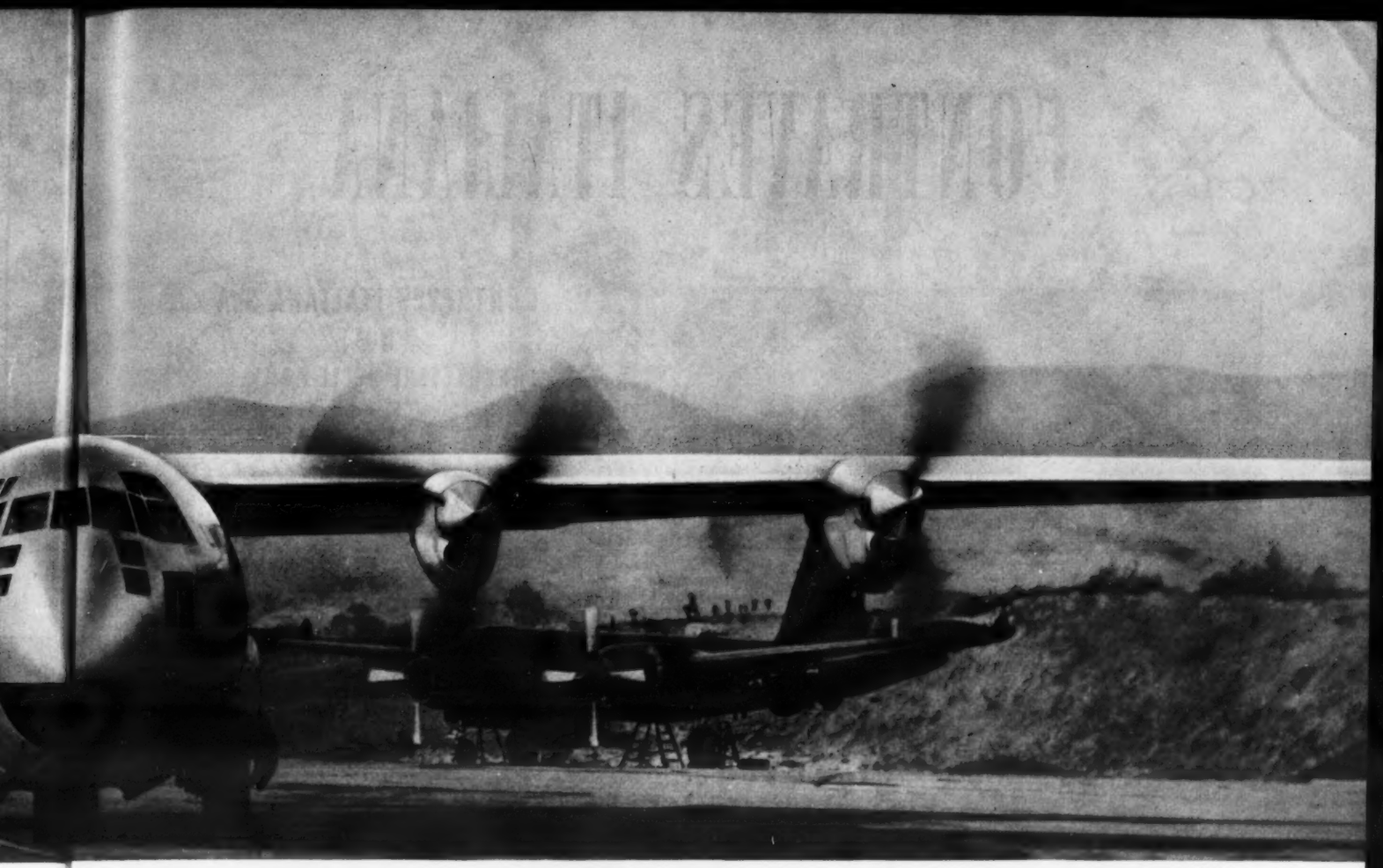
The mighty combat cargo plane illustrated above, the USAF C-130 Hercules, is another Lockheed contribution to jet-age transportation. These new turbo-prop (prop-jet) transports are rolling off America's first turbo-prop production line at Lockheed's Georgia Division Plant—Government Aircraft Plant No. 6, in Marietta, Georgia, U.S.A.

This is America's first turbo-prop transport. Not only extremely fast, the Hercules also will fly great distances, carrying more people or cargo more economically than any other transport.

The unique design of the Hercules—so close to the ground—speeds up the handling and movement of cargo and men. This permits direct truck loading and unloading from the plane's side doors. A huge rear-door ramp lets vehicles actually drive aboard.

The economy of the Hercules makes possible a tremendous growth in future air cargo, reducing handling operations, cutting time and costs.

New sister ship of the Hercules is the Lockheed turbo-prop Electra, a completely new passenger transport now in production. American Airlines—leading airline in the Americas—already has ordered 35 Electras, with deliveries beginning in 1957.



INTERCEPTION. (Right) This condensation trail is a phenomenon caused by great speed at high altitude —symbol of the U.S. Air Force's new F-104 Fighter, the Lockheed supersonic interceptor too secret to photograph.

Lockheed

AIRCRAFT CORPORATION

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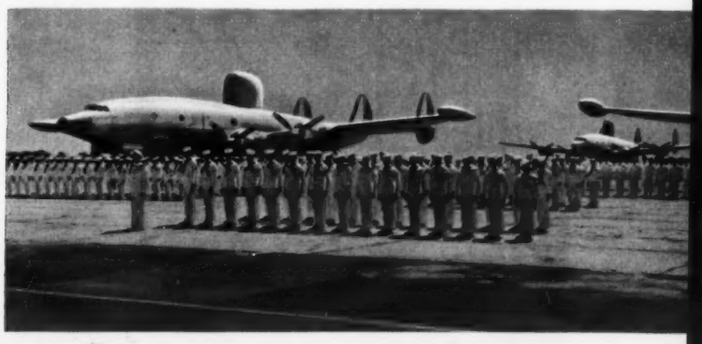
Lockheed Aircraft Service, Burbank, U.S.A.

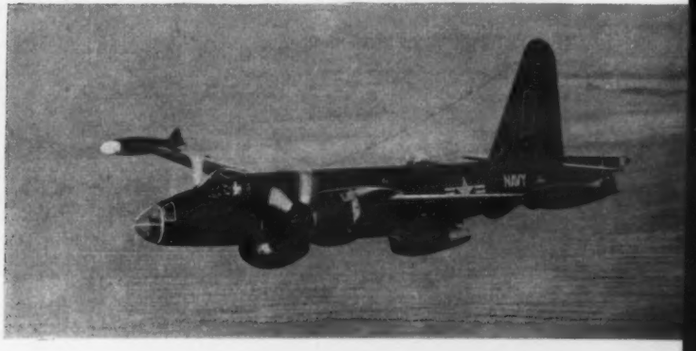
LOOK TO LOCKHEED FOR LEADERSHIP

JET TRAINING. Aircraft carrier jet fighters require highly skilled pilots and, to train them, the U.S. Navy needed the world's safest jet trainer. The new T2V-1, the Navy's first carrier jet trainer (shown below), is a product of close Navy-Lockheed cooperation. Flying about 600 mph, it can land under 100. Better visibility and a raised empennage for improved control are other new features.

EARLY ENEMY DETECTION. Like climbing a mountain for a better view, the U.S. Navy and Air Force "go upstairs" with radar stations on Super Constellations—long-range planes capable of carrying *tons* of 360° radar. Result: more hours of earlier warning. Below, Navy crews at Pearl Harbor pass inspection near their Early Warning Super Constellations.



COASTAL PROTECTION. The U.S. Navy and Lockheed have continuously developed Neptune Patrol Bombers (P2V) for coastal protection from submarine or air attack. In addition to high speed and long range, this plane (below) typifies Lockheed's leadership in the application of electronics to aircraft. Neptunes are in service with the military Forces of Great Britain, France, Netherlands, Australia, Canada and U.S.A.



CONTRAVES ITALIANA

CONTRAVES ITALIANA SpA
ROME
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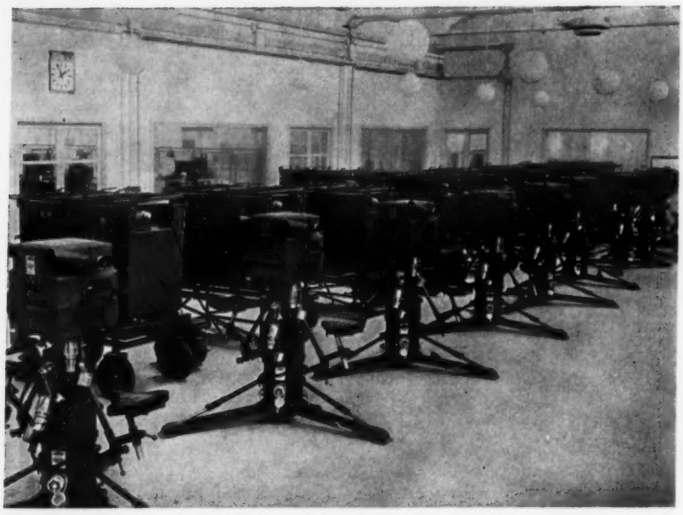


CONTRAVES "F90" DIRECTORS:

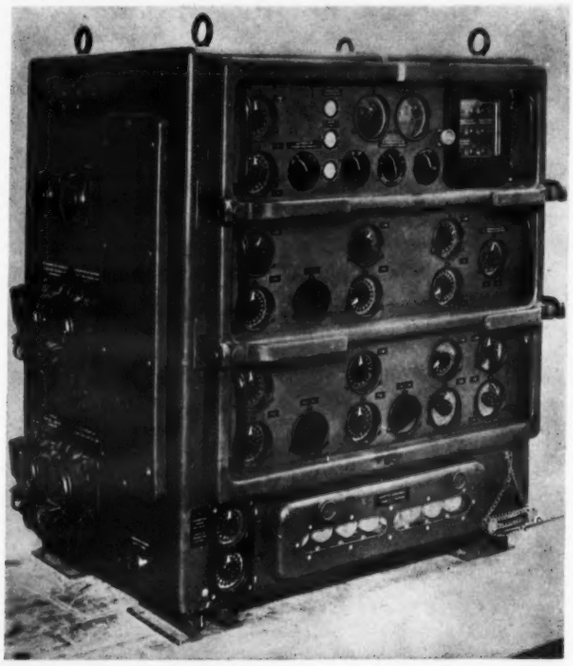
Readiness for action

Operation in snow, rain, intense cold and heat without adjustments or abnormal maintenance work being required

High precision

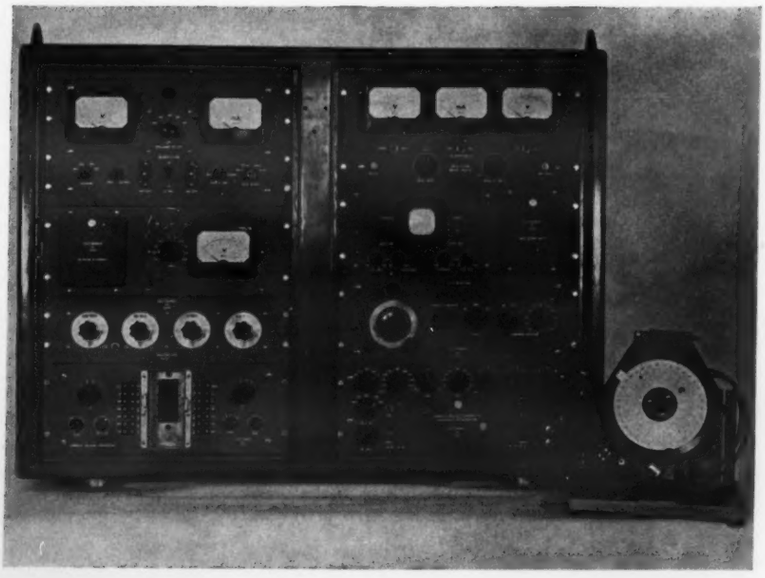
Extreme lightness

Ruggedness; transportable over cross-country terrain without damage



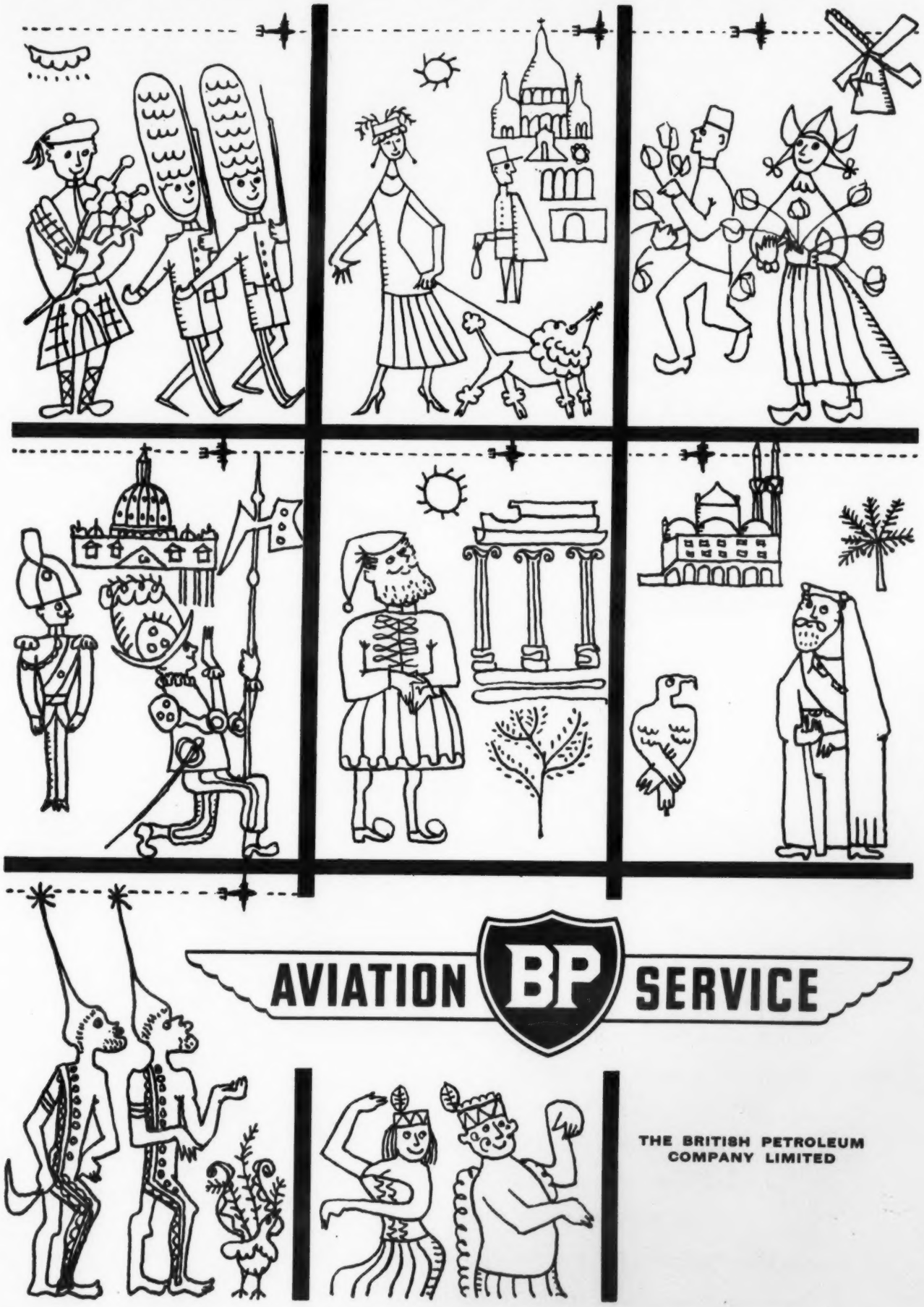
PARALLAX COMPUTER

between search and fire control radar



COMPLETE TEST EQUIPMENT

for use of NATO repair depots for Contraves electronic components



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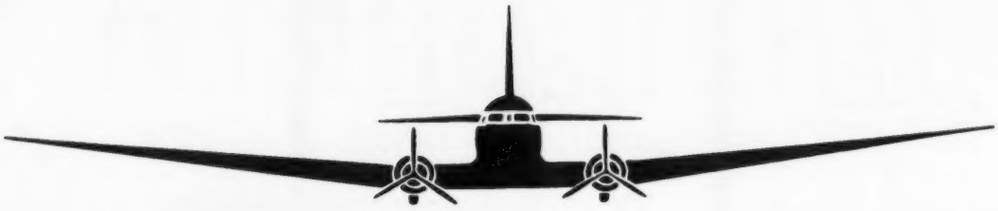
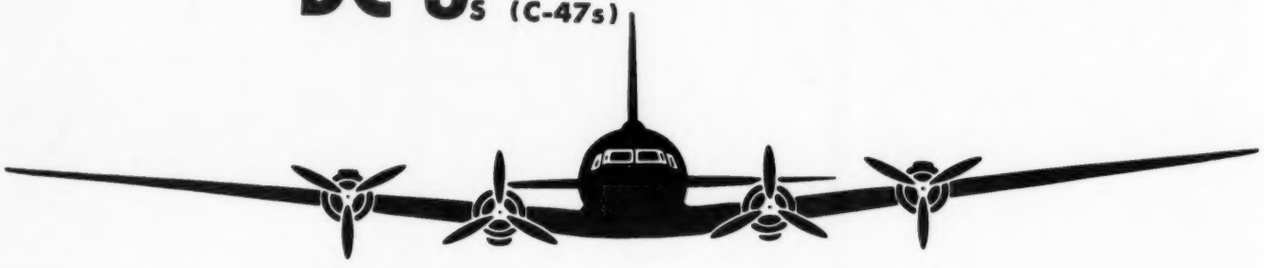
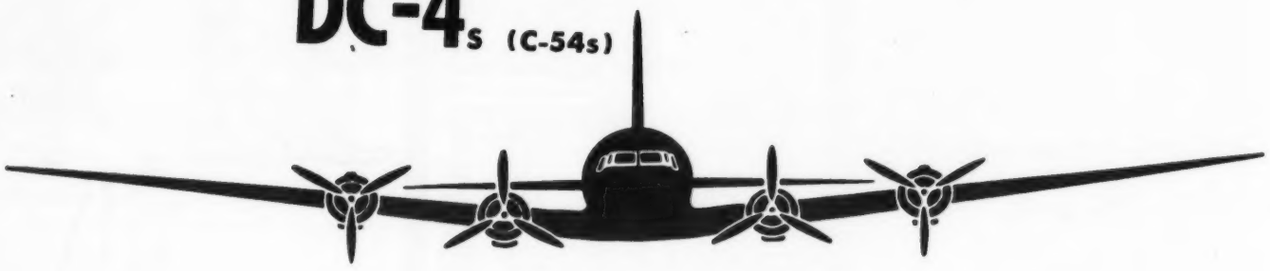


DC-3s (C-47s)



DC-4s (C-54s)



DC-6s (6As and 6Bs)

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The Douglas huge stock of spare parts for the above airplanes assures you of immediate delivery anywhere in the world. And Douglas is still manufacturing more spare parts for DC-3s and later models.

Prompt attention is given to all orders and inquiries. Shipment is made by land, sea or air, according to customer needs. Your Douglas parts and price catalogs will assist you in ordering your requirements.

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Passengers on these aircraft can make use of two small drawing rooms, decorated in fine woods, where they can relax or play bridge.

At meal-times the atmosphere becomes that of a great Parisian restaurant. The exquisite menus, always accompanied by fine wines and vintage champagne, are celebrated throughout the world.

The skill of its pilots, the composition of its fleet and the extent of its network are Air France's best arguments. They have made its luxury aircraft France's able ambassadors to all parts of the world.

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ALL TRAVEL AGENCIES AND AIR FRANCE OFFICES

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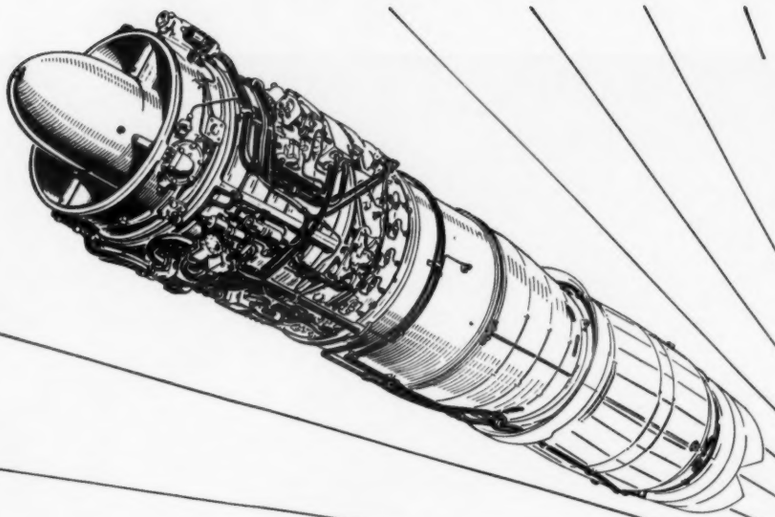

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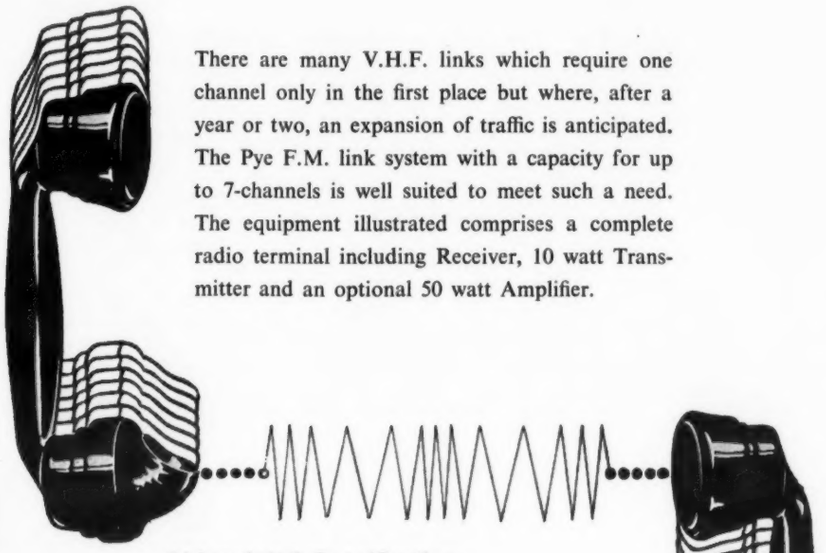

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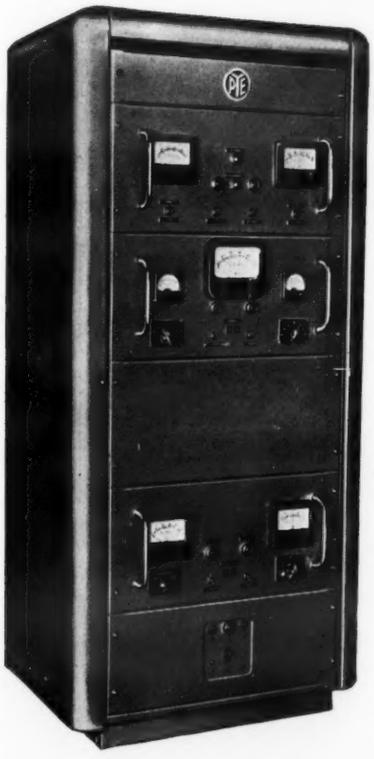

Abbreviated Specification

Frequency range 60—216 mc/s

Transmitter output Power
10 watts, or with Amplifier Unit—
50 watts

Maximum Deviation 50 kc/s

Overall Transmitter-Receiver Performance

Frequency Response
300 c/s—6 kc/s ± 3 db
6 kc/s—36 kc/s ± 1 db

Intermodulation Level
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Receiver Bandwidth 6db down ± 120 kc/s

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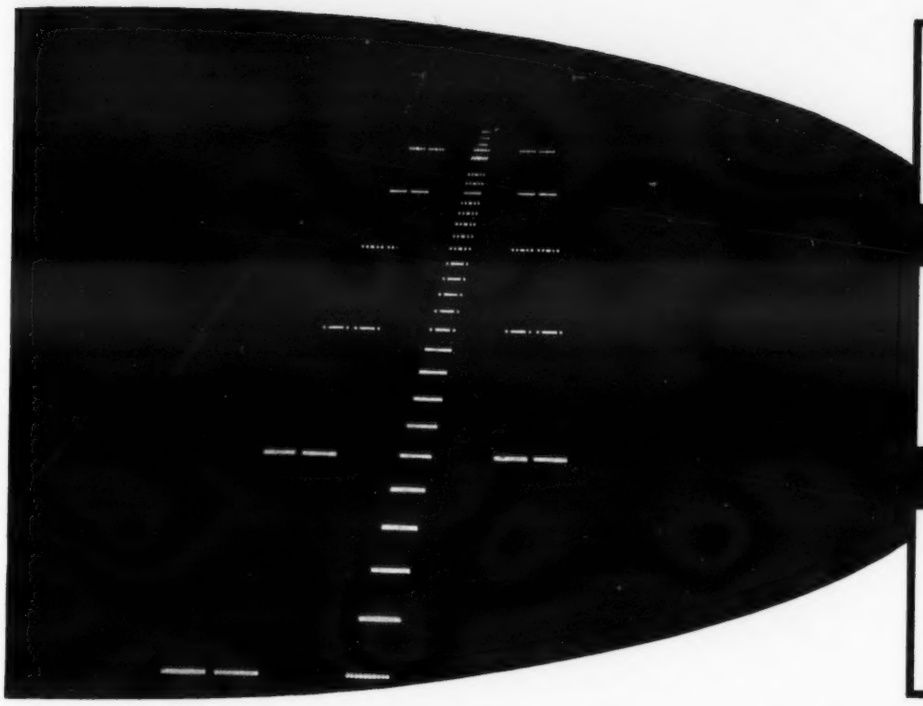

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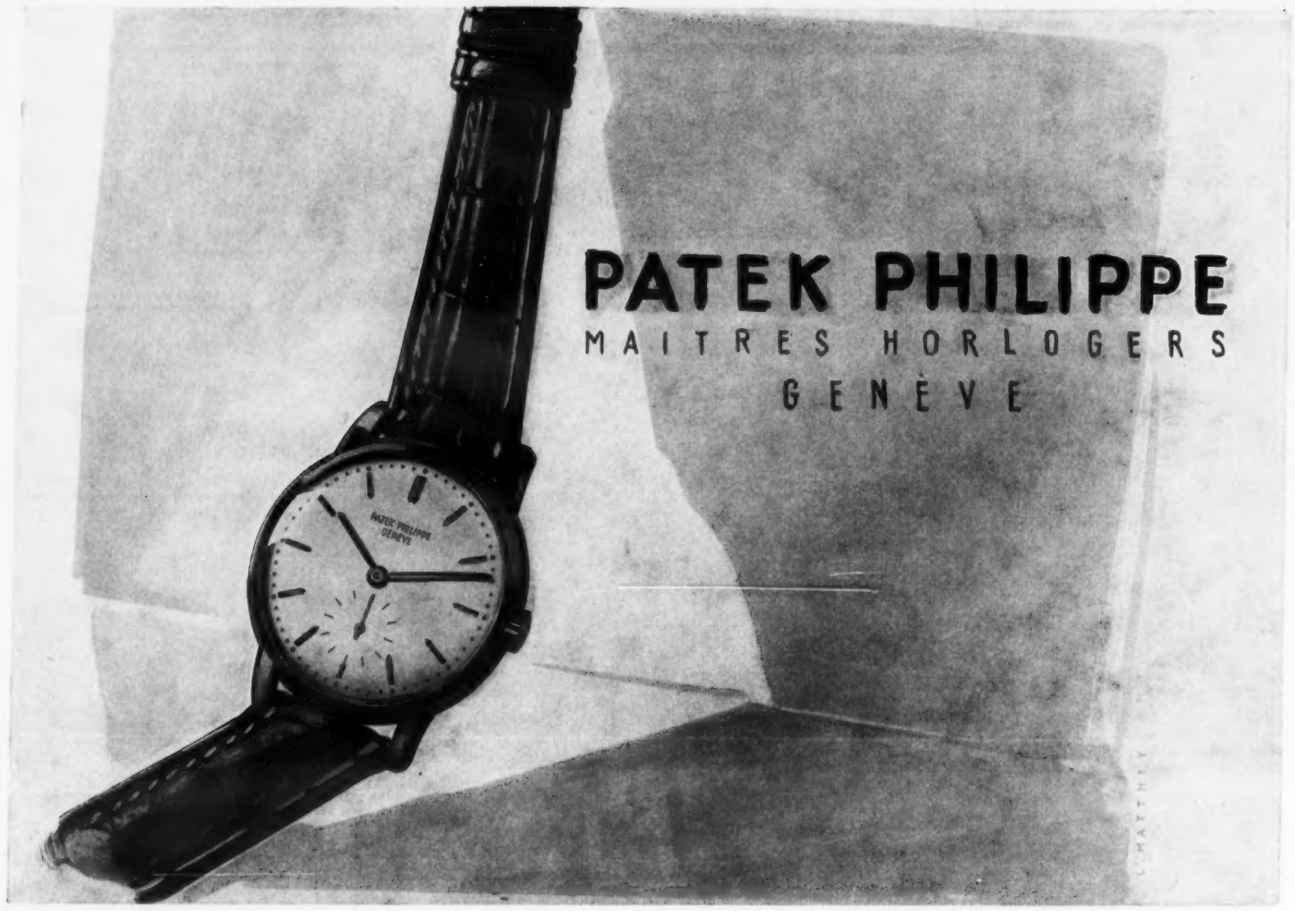

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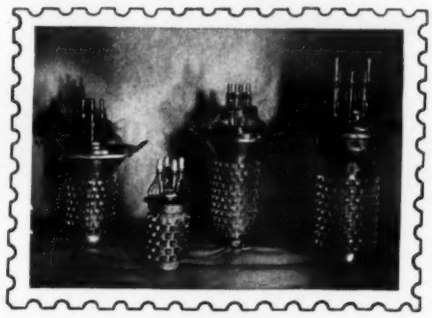
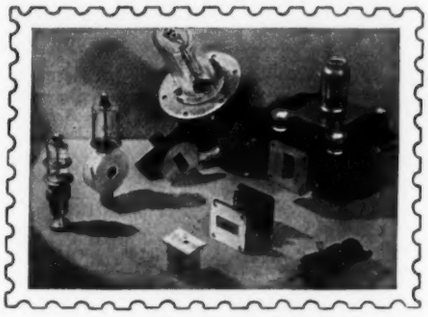
IN THE FRONT RANK OF EUROPEAN

ELECTRONIC MANUFACTURERS



VAPOTRONS

CFTH



VHF TUBES

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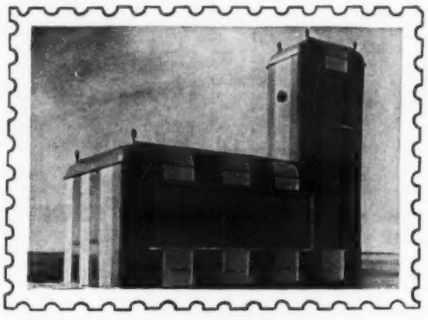

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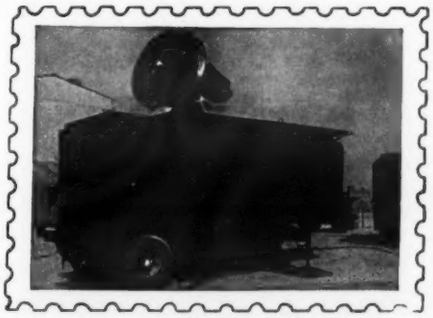

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INTERAVIA

Deadline Notes

No. 10, 1955

SUCCESS OF I.C.A.O. CONFERENCE IN THE HAGUE

After an extremely difficult beginning the I.C.A.O. Conference in The Hague to discuss the revision of the Warsaw Convention of 1929 finally succeeded in reaching agreement, and an additional protocol to the original Convention was signed on September 28th by 26 of the 44 countries represented. On the subject of the air carrier's liability towards its customers, it was agreed that the maximum liability towards each person should be raised from 125,000 to 250,000 gold francs. A new definition was also found for cases when the carrier should bear unlimited liability. - The revised Warsaw Convention will come into force when it has been ratified by at least thirty States.

U.S. FOREIGN AID UNDER SCRUTINY

Four members of the Senate Appropriations Sub-Committee have been in Europe to check ways in which U.S. military and economic aid funds are being spent.

AUSTRIAN AIR SOVEREIGNTY RESTORED

The Austrian Government has resumed its jurisdiction over the granting of commercial flying rights and itineraries. All restrictions on commercial flights over the ex-Russian Zone of Austria have been lifted.

U.S. SPEEDS UP MILITARY AIRCRAFT DELIVERIES

In order to speed up deliveries of military aircraft, the U.S. Air Force may ultimately require military acceptance flights by no more than one in thirty-two planes which have passed company flight tests, it has been stated by Lieutenant Colonel C. E. Moore, U.S.A.F. plant representative at Lockheed.

OERLIKON ROCKETS FOR HOLLAND

It is still too early for a final decision on the most suitable anti-aircraft rockets for Holland's air defences, Defence Minister Staf told Parliament in a message on the Dutch budget proposals for 1956. However, the Defence Ministry has ordered a sufficient number of anti-aircraft rockets from the Swiss firm of Oerlikon Machine Tool Works, Bührle & Co. to equip a complete experimental unit.

SABRES FOR SPAIN

The Spanish Air Force has received its first five North American F-86F Sabre jet fighters. Sufficient numbers of these fighters are eventually to be supplied to equip a whole jet fighter squadron. Provisional base Getafe.

K.L.M. INTERESTED IN DC-8

K.L.M. President A. I. Aler and Executive Vice-President Fritz Besançon recently visited the Douglas plant in Santa Monica, California, to discuss the Douglas DC-8 jet transport aircraft.

THE FRENCH AIR TRANSPORT CONTROVERSY

Despite two attempts, the French Supreme Commercial Aviation Council has been unable to produce a coordination scheme for Government and private air transport that is acceptable to all parties. Meanwhile the private air carriers and the unions representing Air France's personnel are carrying on the argument in press conferences and open letters to Parliament. While the unions complain of "excessive preference being shown to private airlines" by the Government and accuse the latter of "neglecting national interests",

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

the Association of Private Air Carriers retorts that Air France has been able to increase its fleet by 40% in the past three years, whereas the combined fleet of the private operators has fallen by 25% and their share in total French air traffic dropped from 30% in 1952 to 26% in 1954. - The only point on which there is agreement is that some kind of compromise must be found soon, in the interests of French air transport as a whole.

DEATH OF "FIRST CIVIL AIRLINE PILOT"

Captain Bill Lawford, described as the "world's first civil airline pilot", has died at Bexhill, near London, at the age of 70. Lawford inaugurated the London-Paris air route in 1919 with an Airco 4A aircraft, carrying a single passenger and some mail.

CONGRESS TO STUDY "NEWS BARRIER"

The Government Operations Sub-Committee of the House of Representatives, which is slated to investigate the Government's growing efforts to clamp down on the release of news, is planning to pay attention to the Defense Department's latest decree to industrial plants to exercise "considerable caution" before releasing unclassified economic or technical information. Subjects on which such caution is recommended include contract awards, vulnerable points within manufacturing plants and details of expansion of equipment and facilities, production methods, figures on production and production capacity, sources of semi-finished products, sources of power and transportation, security protection for plants, etc.

GERMANY'S FOUR-YEAR ARMS PROGRAMME

West German Federal Chancellor Adenauer has told foreign press representatives that the three-year period for setting up the twelve divisions which Germany is allowed under the Paris Treaty will begin on January 1st, 1956. By the end of 1959 German ground forces will be fully equipped and operational. Equipment of the air and naval forces will take a year longer.

WORKSHOP BRIEFS . . .

The prototype of a Spanish jet engine - the INI-11 P.1 - has delivered a thrust of 2,200 lbs. at 9,000 r.p.m. on the test bench. Development target: 2,860 lbs. at 10,000 r.p.m. * The U.S. firm of Doman Helicopters has submitted to the Royal Canadian Navy a project for a new helicopter for anti-submarine operations. Three General Electric T-58 turbines are planned as power plant. * The Frye F-1, a new "DC-3 replacement" project by Frye Corp. (President Jack Frye, former President of T.W.A.) is designed for four 600 h.p. Pratt & Whitney Wasp engines. The latter could be replaced by four 850 h.p. turboprops if required. * The SE.210 Caravelle twin-jet medium-stage commercial transport built by S.N.C.A. du Sud-Est completed its third test phase on September 23rd, with a total of 61 flights and 112 flying hours. Phase 4 (from September 29th to October 5th) includes tests of transverse stability at different gross weights and c.g. positions. * The Republic XF-105 jet-powered ground attack aircraft is now undergoing flight tests. * Two versions of the Piaggio P.155 amphibian are planned: 1) a sea rescue version with two turboprops totalling 6,000 e.h.p.; 2) an anti-submarine version with a 3,700 e.h.p. turboprop plus two turbojets of 4,400 lbs. thrust. - Piaggio also announces a project for a P.153 Combat Transport, a low-wing monoplane for 9 to 12 persons fitted with A.S. Double Mamba. * The Titmouse is a private venture two-seat sports and training aircraft with Cirrus Minor engine, projected by the design staff of Tiltman Langley Ltd., Redhill, England. * The Bell XH-40 light-weight helicopter under development for the U.S. Army is powered by a Lycoming XT-53 gas turbine. The latter comprises a compressor with five axial and one radial stage, an annular combustion chamber and a two-stage turbine; compression ratio 6.1 : 1. - Take-off power 825 h.p.; max. continuous power 770 h.p. * The first flight of the Vickers Armstrongs N.113D naval fighter prototype is to be made before the end of the year. * The Aviation Traders Accountant commercial transport for short and medium stages will be marketed for £110,000 plus £8,000 for radio equipment. * Crusader is the name of the Chance Vought F8U-1 Navy jet fighter.

* * *

A Decade of the New I. A.T. A.

A birthday bouquet

At the 11th General Meeting of the International Air Transport Association which opens at New York's Waldorf Astoria Hotel on October 17th, 1955, Juan Terry Trippe, President of Pan American World Airways, assumes office as I.A.T.A. President for 1955-56 in succession to Max Hymans of Air France.

Trippe's election is, so to speak, a legacy from the pre-war International Air Traffic Association which decided at Budapest in 1938 to hold its next General Meeting in New York in September 1939 and to make Trippe President at that Meeting. By choosing the P.A.A. President it was hoped to draw European airlines—I.A.T.A. in those days was primarily of European character—into closer contact with the Americans. There was, of course, no I.A.T.A. Meeting in 1939. True, "contact" between Europe and the United States became extremely close during subsequent years, but in a very different form from what had been envisaged in the Hungarian capital.—The old I.A.T.A. perished in the debacle of World War II, but was restored to new life in modified form in 1945.

*

This autumn *the new I.A.T.A. is ten years old*... basically this means ten years of Sir William P. Hildred. Without question the Director General has succeeded in making his Association into a V.I.P. of international life. Whether he organizes his conferences in San Francisco, Paris or Tokyo—tomorrow perhaps even in Moscow—they are always events of major importance attended by considerable pomp and circumstance. Though Sir William's social talents and his highly developed sense of the value of public relations have undoubtedly contributed to this result, the deciding factor has been the perseverence with which I.A.T.A. heads have performed their day-to-day duties.

At I.A.T.A.'s 11th Annual General Meeting in New York on October 17th, 1955, P.A.A. President Juan Terry Trippe (right) takes over the office of I.A.T.A. President for 1955-56 from his predecessor Max Hymans, of Air France (left). Centre: I.A.T.A. Director General Sir William P. Hildred.

The work of I.A.T.A.'s special committees was described in such detail in these pages a year ago*) that a few brief words on them should suffice in the present article. Economics, engineering, legislation, medicine... as air transport has a revolutionary effect on all fields of human life, I.A.T.A. has been obliged to find answers to the most varied questions. It has had to develop an all-round activity and obtain expert advice on a multitude of problems, from child psychology to tropical medicine, taxation and relations with post-war government agencies...

Needless to say, despite this far-flung activity in the interests of improved air transport, I.A.T.A. has not overlooked its main task as an association. In the words of the handwritten agreement drawn up by Major-General Sir W. Sefton Brancker, the creator of British civil aviation, on August 28th, 1919, the *primary object of I.A.T.A. was "to cooperate to mutual advantage in preparing and organizing international aerial traffic."* One example of this work for the common good of members is the highly successful activity of the I.A.T.A. Clearing House, which was created to arrange payments between airlines with the minimum of actual cash transactions. The total sums passing through the Clearing House books have risen from year to year: in 1952 they amounted to $218,249,000, in 1953 to $241,632,000, and in 1954 they had risen to $287,344,000. During 1954, 88.7% of all transactions in scheduled world air transport were completed without cash, and the average handling time from receipt of documentation was down to eleven days.

A. Laurence Young was appointed I.A.T.A. Secretary in 1954.

As regards air transport itself, the extent to which it has grown under the aegis of I.A.T.A. can be illustrated by a few figures. In 1920, the old I.A.T.A.'s first operating year, member companies flew a total of 1,000,000 km and carried 3,500 passengers, 47,000 kg freight and 178 kg mail. Today, with a fleet of more than 2,500 aircraft, I.A.T.A. airlines fly to 3,500 cities in all parts of the world. In 1954 they carried roughly 44,000,000 passengers (77% of the total on the world's scheduled services).

* *Interavia* No. 11, 1954, p. 754 etc.

Sir William P. Hildred has been Director General of the International Air Transport Association since 1946. Before taking up this office he was Britain's Director General of Civil Aviation.

Over the Atlantic alone twelve I.A.T.A. companies made 15,000 crossings and recorded 580,000 passengers.

. . . but no rose without a thorn

However gratifying these results may be, neither I.A.T.A. nor world air transport are best served by hymns of praise alone. What both need for their healthy development is objective criticism. And here it must be admitted that, despite passenger figures measured in millions, and despite the speed and comfort of modern air travel, there are still some strange things that happen in international air transport.

A striking example was provided recently by the following action of the Canadian authorities.

Passengers not admitted

On August 10th, 1955 a Swissair DC-6B operating the Zurich—New York service unexpectedly had to land at Montreal, Canada, because of bad weather in New York. In addition to passengers for the United States, the aircraft carried several with air tickets on from New York to a number of Canadian cities, including a man of 84 and a woman with two babies who lived in Montreal itself and several passengers whose final destination was Toronto. These latter were naturally overjoyed at the "incident", believing that it would save them the detour via New York and get them home unexpectedly early. But they had reckoned without the Canadian air transport authorities who carefully examined the situation and came to the following conclusion: there is no air transport agreement between Switzerland and Canada to permit Swissair to make "commercial" landings in Montreal, that is to take up or set down passengers or cargo at Canadian airports. According to the letter of the law, the incident in Montreal was purely a "technical" landing. Thus, as neither the Swiss DC-6B nor its passengers had "any business" in Montreal, they were to leave the city as soon as possible for the United States. Urgent telephone calls, intervention by relatives who had come to meet passengers in Montreal, tears and entreaties... all were of no avail; the Canadian authorities in Ottawa remained adamant. After a six-hour wait at Montreal Airport, the DC-6B took off again with its full passenger complement for New York...

What lends piquancy to the story is that this return to the age of the stage coach took place

Too little customer service . . .

The person concerned in the following anecdote told his story to the Editors at *Interavia*'s offices:

During the "Big Four" Conference in Geneva in July 1955 the telephone rang one night by the bedside of a senior official of a West European city. Awakening from a deep sleep at 2 o'clock in the morning, he was told by the secretary of one of the Western Foreign Ministers that the Minister needed him in Geneva as soon as possible.

Thinking quickly, he decides to take the next aircraft to Geneva and telephones his country's national airline. No reply, all the offices are closed, and there is nobody on duty at the telephone. He has no idea what time the next aircraft leaves or whether he will be able to get a reservation on it. But orders are orders, so he gets out his car and drives into town to try his luck at the travel agencies and finally at the railway station. All the travel agencies are in darkness, and the station enquiry office can give him information about trains but not about air services. There is nothing to do but drive home again and go back to bed. At 8 a.m. he begins his telephone enquiries again. Shortly after 9 a.m. the airline answers, only to tell him that the morning aircraft is about to leave, but that there is a seat free on the afternoon service. He finally arrives in Geneva towards the evening.

If the same situation had arisen in a major U. S. city, the joint booking office maintained by all the airlines operating to the city would have been able to give him clear and rapid information at any hour of the day or night. He would certainly have been able to catch the next aircraft, if there had been a seat for him on it. But in Europe every airline works on its own behalf, despite the fact that all belong to the same association. There is no such thing as a common booking office, either in London or Paris, Rome or Zurich.

Customer service? Back to the stage coach!

Too much customer service . . .

The road to hell is paved with good intentions . . . As the Chief Enforcement Officer put it in I.A.T.A. Bulletin No. 15 of June 1952: "The enforcement process should not, of course, become a drain on the treasuries of I.A.T.A. members or a ubiquitous nuisance to their personnel . . ."

The following is a true story:

It began at Cointrin Airport, Geneva. An elderly man, holding the usual European tourist-class ticket, embarked on a European airline's aircraft which had landed in Geneva on its way from South America to Frankfurt, for a flight lasting at the outside an hour and a half. It was a hot summer's day, and the passenger was obviously suffering from the heat.

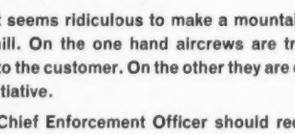
The hostess showed him to a seat in the rear cabin of the Douglas DC-6, and he noted that the rear cabin was full while the forward cabin was almost empty. Politely he asked if he could not move forward, to which the hostess, who felt sorry for the old gentleman, agreed. After a comfortable short flight the passenger left the aircraft with expressions of gratitude, little knowing what would be the consequences of his action.

Though holding only a tourist-class ticket he had occupied a seat in the luxury cabin. The hostess had probably thought of this, but not considered it of vital importance, as the journey was so short. She also could not have known that a member of I.A.T.A.'s Enforcement Office happened to be on board, on the look-out for breaches of I.A.T.A. rules. He reported the case, and the "guilty" airline was sentenced to pay a heavy fine.

Admittedly, the I.A.T.A. Enforcement Office exists to prevent members from breaking I.A.T.A.'s tariff rules. Admittedly a tourist-class passenger should not occupy a first-class seat. In any case this should not be made a rule. The classes are strictly segregated on the railways and in ships.

But it seems ridiculous to make a mountain out of a molehill. On the one hand aircrews are trained in service to the customer. On the other they are deprived of all initiative.

The Chief Enforcement Officer should reconsider this case and see that it is not repeated.



Dr. Henryk J. Gorecki, Treasurer, was Manager of the Polish airline LOT before World War II. He was a member of the founding committee of the new I.A.T.A.

John W. S. Brancker, Traffic Director, formerly a senior official of British Overseas Airways Corp. – His father, Air Vice-Marshal Sir W. Sefton Brancker, creator of British civil aviation, wrote the document setting up the old I.A.T.A.

S. Krzyczkowski, Technical Director, transferred from the Polish to the Canadian aircraft industry during World War II (Manager of Aero Tool Works Ltd.) and has been a I.A.T.A. officer since 1945.

Professor John C. Cooper, well-known American air law expert, is I.A.T.A.'s Legal Adviser.

Julian G. Gazdik, secretary of the Legal Committee.

S. Ralph Cohen, Public Relations Officer.

Air express in Europe . . .

A Swiss couple staying in Paris just missed eating caviar . . . The husband hurried back to the hotel one afternoon to give his wife the good news: a friend, anxious to offer them something special in the way of entertainment, had procured for them an invitation to a reception by the President the following evening. Evening dress "de rigueur".

The poor wife had, of course, nothing to put on. In any case she had left her evening clothes behind at home. However, she telephoned her maid, and the husband his office. An hour later he was told the dress was being sent to Paris immediately by Swissair and could be picked up the same evening at the airport.

Sure enough, three hours later Swissair's freight department announced that the dress had arrived. It still had to be examined by the customs authorities, and the customs office was already closed for the night. But all the necessary arrangements would be made first thing the next morning, and the dress would be delivered to the hotel by noon. Everything seemed to be going well . . .

The parcel had taken a bare two hours to get from Zurich to Paris. But the ways of air freight are past comprehension, and it took another twenty-four hours to get from the airport to the hotel.

First there had to be a customs examination, despite the fact that the gown was not new and could therefore be classed only as "personal effects". Then Europe still lacks the kind of organization that already exists in the United States. In the latter country, which in any case knows no internal national or customs frontiers, there has long been a uniform organization to deliver railway freight—the *Railway Express Agency*, which works for all the private railway companies. A few years ago this company formed a subsidiary, *Air Express*, to handle air freight. Its trucks can be seen in almost every American city.

In Europe the airlines either deliver their freight themselves or leave it to local carriers. But there is, at any rate so far, no European organization similar to the American. And this is one of the reasons why European air freight does not work as well as it should and could.

. . . And why the President of France's reception, for example, took place without its Swiss guests.

twenty minutes from the International Aviation Building in Montreal, the headquarters of the International Civil Aviation Organization and the International Air Transport Association. Did anybody ask the two organizations for their assistance in this matter? Whether they did or not, probably neither I.C.A.O. nor I.A.T.A. would have been able to do anything about the decision which the Ottawa authorities had taken in the full exercise of their sovereignty.

Yet in big, well illustrated advertisements in newspapers throughout the world Canada invite foreign tourists to visit her cities and natural beauty spots. One of the latest of these advertisements includes the words:

"Nowhere is travel so trouble-free and comfortable as in Canada"... No comment.

European interest in I.A.T.A.

During a recent air transport debate in the Bonn Parliament a deputy made the statement that I.A.T.A. was nothing but an international price cartel, under American domination. Though this definition is somewhat exaggerated and is rejected by the majority of European airlines, it cannot be denied, on the other hand, that some of I.A.T.A.'s regulations, fare rules and measures are tailored to fit conditions in the New World rather than the Old. As regards scope and equipment, U.S. air transport is quite simply in the lead.

U.S. airlines, financially strengthened during World War II and the Korean war have long, profitable domestic routes with high traffic volume and no national frontiers to cross. In its summer 1955 issue, United Aircraft Corporation's "Bee-Hive" states that 85% of all persons using common carriers in the United States (air, rail, bus) over distances of 1,500 miles or more go by air. The position of the air carriers as regards procurement is no less favourable. They are, so to speak, at the source, buy their flying equipment more cheaply with no freight or customs charges, have spares

What the passenger has to say . . .

". . . Anyway, it would be a good thing if the air transport people developed a better sense of time, particularly on the ground."

Actually the elderly gentleman sitting in an armchair opposite the writer and allowing himself to be interviewed with a reflective smile appears to be in no hurry . . . But appearances are deceptive. There can be few persons who are so dependent on fast travel as Professor Theodore von Kármán, one of the airlines' best customers.

"If a train is a few minutes late in leaving," said von Kármán, "railway officials run around busily. But an aircraft? Recently we were waiting to take off at an American airport. Five, ten, twenty minutes. After half an hour came the answer to the riddle, in the form of the man who was to deliver the thermos flasks of coffee for the passengers.

"It is astonishing," continued Professor von Kármán, "how much time is wasted in ascertaining whether a booking is in order. The official telephones from one office to another to ask how many seats are occupied, whether the passenger is on the list and all the rest. In my opinion it is high time air transport got to the position where the traveller goes to the booking office—as at a railway station—buys a ticket and gets into the aircraft.

"A few weeks ago I decided to try making a complaint. I had booked a flight from Dallas, Texas to Phoenix, Arizona and been told that take-off was at 6.30. I therefore arrived at the airport at 6 a.m., but the aircraft did not appear until just before 8 o'clock. So I took one of the 'complaint cards' provided in the cabin and wrote to the president of the airline: 'Dear Mr. Smith, Cannot something be done to increase punctuality of services? When your competitor, Pacific Union Railroad, is more than an hour late, part of the fare is refunded . . .' Two weeks later I received the following reply: 'Though we are always grateful for suggestions, we regret that in the present case there is nothing we can do. Apparently you are not fully conversant with the basic principles of air transportation.'

"Otherwise I have no complaints about air travel. I enjoy flying and appreciate the trouble taken to please the passenger. One more small suggestion. At most airports the distance one has to walk to the aircraft seems to me to be too long. There are elderly people who do not enjoy a route march with a heavy briefcase. Admittedly wheel chairs are provided for people who are sick. But a healthy person does not like to use such a vehicle, even if he is elderly. And there should be a little more standardization in cabin equipment. The individualism prevalent today goes a little too far. Sometimes the passenger just does not know where to look for the different levers and switches."

Whereupon Professor von Kármán left by taxi for the airport to spend a few hours in Paris.

depots almost on their doorsteps, and the fuel they use flows from American ground.

Yet, in the interests of standardization in rates and regulations, the adoption of American systems has been imposed, at times almost ruthlessly, on a Europe geographically less favourably situated and impoverished by war, without regard for the fact that conditions in Europe frequently are quite different. Tourist rates were introduced on Europe's short-distance routes that, despite the lower European standard of living and the weakness of certain European currencies, are actually higher than American rates. In the true sense of the word, there are no tourist- class passengers in Europe yet; the people who travel by tourist class in Europe are businessmen and the wealthier classes, but strictly speaking they are first class passengers. Europe is still very far from producing the same percentage of air travellers as the United States.

Arthur J. Quin-Harkin, head of I.A.T.A.'s London Clearing House, which in the eight years of its existence has handled transactions between I.A.T.A. members to a total value of $1,376,472,000 without cash payments.

Vladimir de Boursac, Secretary of I.A.T.A.'s European office in Paris.

The European air traveller probably notices this less than the carriers, who have been trying since 1953 to organize themselves, not in any way to compete with I.A.T.A., but purely for self-preservation. The late Italian Foreign Minister Count Sforza submitted to the Council of Europe at Strasbourg a plan for a European air transport pool which was ahead of its time. In 1954 there was another meeting in Strasbourg, but, because of conflicting national interests, it had to content itself with recommendations. The most significant of the latter was for the creation of a Permanent European Air Transport Conference, but this too so far

The arithmetic of free flights

You can fly round half of Europe *without extra charge* if . . .

If, for example, you buy an air ticket from Dakar to Rome, you can then make a detour via Paris or Madrid or Barcelona and Nice. If you want to fly from Dakar to Brussels, you can spend a day or two in Lisbon, Paris and London on the way. If your journey is from Dakar to Zurich, you can call without charge at the Portuguese, Italian and French capitals. This is no lyrical overstatement, as may be proved by a joint leaflet issued by two American airlines.

These free zig-zag flights are by no means restricted to services between Dakar and Europe, but apply to a great number of long-distance routes operated to Europe by a variety of airlines. The magic words which open these unsuspected possibilities for the air traveller are "common rate points" and "gateways".*

Historically this "bonus system" is not difficult to explain. Assume an airline operates between Karachi and Amsterdam. Obviously several intermediate stops must be made on the way. If, for example, the only Middle East stop is at Beirut, passenger volume would be relatively restricted. But if the airline lands alternatively at Beirut, Baghdad or Cairo, the circle of possible passengers is immediately greatly enlarged.—The next obvious move is to allow the passenger to benefit by these variations in route, by permitting him to stop over at the various points of call without extra charge.

In order to introduce a little system into the arrangement, Europe was divided into three or four regions, within which a passenger can fly to a number of cities without supplement—these are the common rate points. The only restriction is that the detour shall not exceed 15% of the original journey length and must terminate at the same gateway: Shannon, Prestwick, etc.

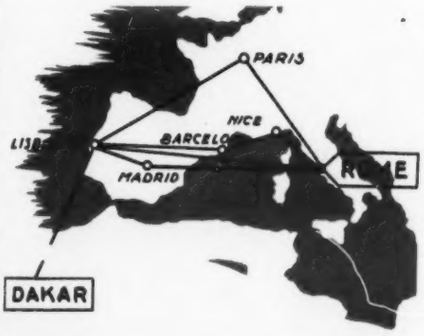
Basically there is nothing wrong with this, especially as these privileges are not restricted to certain airlines, but can be granted by all, thus providing a kind of group publicity for air transport as a whole. It becomes difficult only when the booking official has to explain to a passenger which routes he can use and which he cannot. At this point the system of common rate points becomes a secret science.

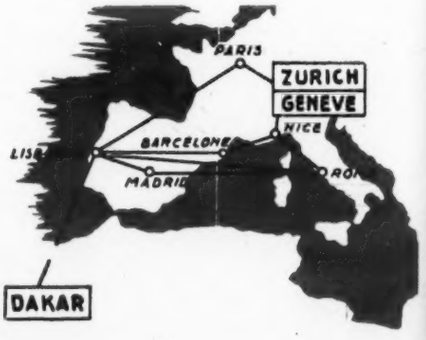
For example, a passenger on the Zurich–Amsterdam–New York route can make a small side trip from Zurich via Stuttgart to Paris. On the other hand, a trip in the other direction: Zurich–Paris–Stuttgart–Amsterdam would not be permitted, even if it did not exceed the original distance by 15%, because then the gateway direction would not be correct. Another example: a first-class New York–Amsterdam–Paris ticket costs $ 420. If the passenger is unable to make use of the Amsterdam–Paris section and claims a refund on it, the booking official is obliged to tell him he can get nothing back. Why? Because the flight to Paris, a common rate point, represents the "bonus", or, in other words, the New York–Amsterdam–Paris flight costs the same as the shorter flight from New York to Amsterdam, namely $ 420.

One of Europe's major airlines arranged for an experienced booking official to initiate the writer into the secrets of the common rate points system. He spent two hours on the job, referring to a 900-page manual and occasionally biting his pencil.

One question appears to be justified: Would it not be possible to make things a little less complicated?

* *Common rate points* are the cities in a given region to which long-distance passengers can fly for the same price. — *Gateways* are the terminals for long-distance routes, for example Shannon for the North Atlantic routes, Lisbon for the South Atlantic, etc.





exists only on paper. Certain airlines have meanwhile taken somewhat more practical steps and come to joint agreements, which W. Deswarte, Sabena's Managing Director, and Dr. H. L. Slotemaker, Executive Vice-President of K.L.M.-Royal Dutch Airlines, discuss elsewhere in this issue.

All this is in preparation for another European air transport conference which I.C.A.O. has called in Strasbourg, headquarters of the Council of Europe, for November 29th, 1955, and which should, if present hopes are not disappointed, get a step further.

It is significant that not only the intergovernmental I.C.A.O. but also the interairline I.A.T.A. are showing considerable interest in the preparation of this conference. Only a few years ago the latter Association regarded any such tendencies as incipient "separatism" (cf. *Interavia* No. 4, 1955, p. 237, end of the article). If healthy and effective cooperation can be achieved in European air transport, such a continental association would be nothing more formidable than a balance to the Air Transport Association of America. In forming the latter, U.S. airlines have already clearly shown the way! It insists that its members cooperate suitably within the United States, it protects them from harmful competition among themselves, it defends their interests. But these same members are in no way influenced by A.T.A. in any direction that might interfere with I.A.T.A.'s worldwide aims; they are in no way prevented from being loyal and useful members of I.A.T.A.

*

The new I.A.T.A.—which today counts no fewer than 74 member airlines—now has its first decade behind it. By the time it celebrates its second decade such teething troubles—for that is what they are—will have been overcome. *Without* I.A.T.A. international air transport would have bled itself white in bitter rate wars . . . *Without* I.A.T.A. there would be no world air transport! *EEH*

Thoughts on Strasbourg

The first European Civil Aviation Conference: A challenge to Europe

BY DR. L.H. SLOTEMAKER, EXECUTIVE VICE-PRESIDENT, K.L.M. ROYAL DUTCH AIRLINES, THE HAGUE

Since the revival of international civil aviation after World War II, no generally satisfactory formula has been found for the international regulation of commercial civil aviation, notwithstanding numerous efforts and expert studies. Airlines have sprung up like mushrooms everywhere and all of them are trying to expand. It has been no easy matter to give each a fair deal. The most obvious solution, which was the one followed in pre-war days, was again adopted: to each country its own air space and hence its own traffic. In the international community this in turn resulted in barter—the most primitive form of trade—becoming part and parcel of civil aviation. For the operation of an international route passengers, commodities and mail are exchanged among the airlines of the countries concerned. This reciprocity in fact dominates international civil aviation, at least so far as it concerns countries with their own airlines operating internationally.

Generally speaking nobody wants to exchange a "thoroughbred" for a "cart horse", though it should be realized that the thoroughbred and the cart horse in question are, after all, the passengers who travel to and from a given country.

This bilateral trading between governments in what is called "commercial rights" has never been quite satisfactory because civil aviation should serve general and more idealistic interests than is now the case. Moreover, it soon became apparent that it is not possible to operate air routes economically under this bilateralism. Some of the causes are the instability inherent in the system and the great number of restrictions it imposes, since it is necessary to make a separate agreement with each country along a route. The result is a lack of uniformity among the agreements. It has become clear that only multilateralism can overcome these objections. The efforts which were undertaken in this respect and culminated in the discussions within I.C.A.O. at Geneva in 1947, however, came to nothing. After Geneva there was great scepticism about the possibility of concluding a worldwide multilateral treaty. This became apparent at I.C.A.O.'s 7th Assembly at Brighton, where the conclusion was reached that a universal multilateral treaty was not then possible and that it would, therefore, be preferable to strive for regional and/or partial solutions. The Strasbourg Conference for the Coordination of European Air Traffic in 1954 offered an excellent opportunity to achieve one such regional solution.

Some bold plans were put forward at this Conference: a British plan advocated the abolition of the distinction between one country's traffic and another's, but at the same time it made the right to operate a route dependent on the amount of traffic an operator's country could generate, and it thus took back with one hand what it had given with the other.

There was also a Scandinavian proposal for a general multilateral treaty based on complete freedom; and a French/Netherlands proposal to grant airlines greater greedom to grant operational rights on routes to and from their countries. Partial solutions were also put forward: greater freedom for non-scheduled traffic, greater freedom for freight traffic.

The final recommendations passed by the Conference, which were of a more limited character than the plans mentioned above, advocated among other things, progressive cooperation between airlines to be furthered by Governments; the drafting by the I.C.A.O. Council of a European Multilateral Treaty for scheduled air services; greater freedom for "all freight services" within Europe; framing of a multilateral treaty for non-scheduled air services and an interim liberalization of certain categories of non-scheduled flights.

At the same time there was a proposal to institute a "European Civil Aviation Conference" which would normally meet once a year and supervise the implementation of the recommendations. The first meeting of this Conference will take place on November 29th, 1955. The agenda is limited, but of the greatest importance. Besides matters of organization, the problem of European multilateralism will come up for further discussion.

At first sight, and if previous history is taken into consideration, there does not appear to be much hope for spectacular results. The attitudes of the various governments have not undergone any important changes, and no new solutions for a compromise have emerged. At most it would seem that some progress will be made along the lines put forward during the Strasbourg Conference of 1954, to wit, a clearer stand regarding ways and means of cooperation among the airlines, and possibly some progress towards the liberalization of freight traffic and a partial solution for some forms of non-scheduled operation.

The way leading to regionalism, that is to say, the search for solutions offering greater freedom—at first on a regional level and later to be extended to greater geographical units—will therefore initially appear to be a very narrow one. Actual multilateralism will require further study unless there is some easing up of the reserve now shown by governments towards the activity of foreign airlines in their countries and unless there appears to be a true desire to put international and, therefore, European interests before direct national interests. Only when the existence of a common European interest is recognized, to which national interests must be subordinated, will it be possible for European civil aviation to work on a permanent multilateral basis.

In the main it may be said that two possibilities are open: (1) a joint all-European operating combine under a European authority for civil aviation or (2) complete freedom for European civil aviation, a "joint aviation market." When making the choice it must be remembered that under a European combine competition in Europe would be all but eliminated and this would provide no guarantee of most economic operation of the routes. On the contrary, the European area of operations of various national companies would be subjected to regulations which would predetermine the operation of the remainder of their networks. In this way the freedom to build up a national network in the most economical way would be considerably curtailed.

The formation of a single European airline company either for operation within Europe, or for the operation of trunk lines, or for both, would be able to meet these disadvantages, in the opinion of some observers. Apart from the doubtful desirability of creating such a great body, which would have the monopoly of operations in Europe or of European operations altogether, such plans are not feasible at the present time. The majority of European countries have nationalist outlooks and have the greatest difficulty in agreeing even on matters of European interest of a more limited nature.

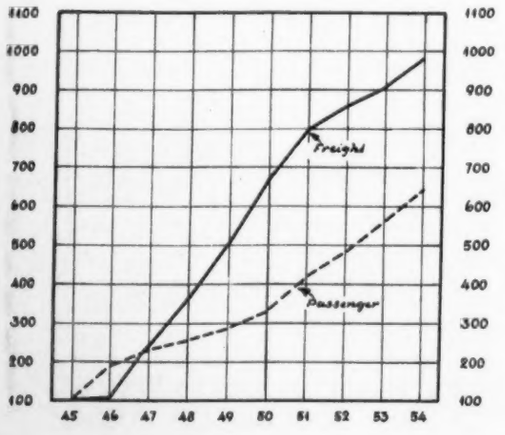
There remains the other possibility of a liberalization of air traffic in Europe. This solution has the advantage that each country would have the opportunity of proving its national strength in the field of aviation, while the resulting competition would be a guarantee that operational expenses would be kept on an economic basis, provided that the rules of the game are drawn up in a spirit of fairness and that, among other things, no unjustifiable subsidies or uneconomic practices are permitted.

In a remarkable article in "Transport and Communications Review" of October-December 1954, Mr. Curtis of Hunting Clan Air Transport enumerated a number of prerequisites for such a development:

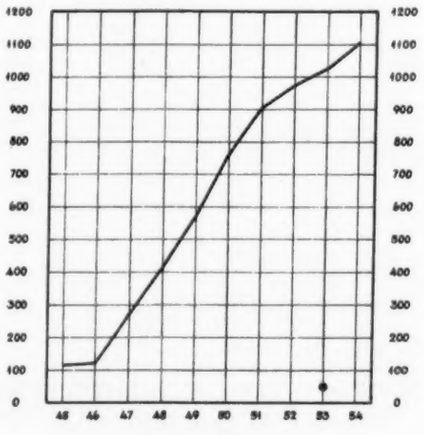
— Freedom from all forms of subsidy;
— Freedom of commercial access to all countries;
— Freedom of carriers to buy the equipment best suited to their requirements;
— Freedom to form trade associations, independent of government supervision, to regulate the industry's conduct.

Under such a system international civil aviation would be judged on its own merits, independent of national politics. If, in fact, a true European policy is being pursued, then this dissociation of civil aviation from national politics should not be difficult. However, lack of confidence in their own strength still induces nations to grant their own national civil airlines every possible protection. For this reason the road to greater freedom within Europe seems closed at least for the time being. Meanwhile, further expansion of civil aviation is difficult on account of present extreme protectionism. Thus Sir William Hildred

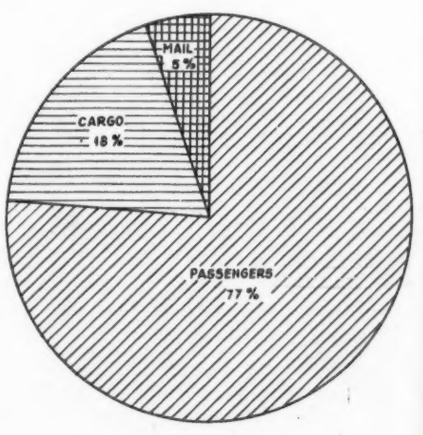
DEVELOPMENT OF WORLD AIR FREIGHT TRANSPORTATION COMPARED WITH WORLD AIR PASSENGER TRANSPORTATION (1945 = 100).



DEVELOPMENT OF WORLD AIR FREIGHT TRANSPORTATION (in million tonne-kilometres). This graph shows the development of freight carried by regular air carriers all over the world (U.S.S.R. and China excluded). – The asterisk indicates the amount of freight carried in Europe in 1953.



DISTRIBUTION OF WORLD AIR TRANSPORTATION IN 1954 (Revenue).



observed that "our remaining hope for expansion lies in the cargo fields," though his statement was no doubt prompted by the economic rather than by the political aspect of the present situation in civil aviation. However, it will be clear that there is a direct causal connection between the political and the economic position.

Now the next Strasbourg Conference will certainly be able, and consequently more or less obliged, to make some positive and constructive resolutions.

A possibility of action for expansion in the cargo field is found in the Recommendation of the Strasbourg Conference of 1954, which strongly urges liberalization of all freight services. The nations were to accept, by October 1st, 1954, such liberalization tentatively for a period of five years. Finland, Ireland, the Netherlands, Norway, Denmark, Sweden, Portugal and the United Kingdom informed I.C.A.O. that they intended to implement this Recommendation. France and Greece reacted negatively.

A policy of freedom for freight traffic should, however, not make any distinction between freight on "all-freight" services, on non-scheduled services, or on regular passenger services.

It would be carrying prudence to the extreme to make artificial restrictions in a field in which so much expansion is still possible.

The graphs show to what extent world air freight traffic has increased relatively and absolutely since the last world war as compared with passenger traffic. Furthermore, the European share is shown for the year 1953, which was only 3.8%. The forthcoming Conference could produce a *concrete result* in this field and could fix, for instance, April 1st, 1956, as the deadline upon which liberalization should become effective.

A further partial solution would be for the Conference to agree to the *liberation of air mail from political restrictions.* The Congress of the International Chambers of Commerce, held in Tokyo in 1955, adopted a resolution urging freedom of air mail traffic. In view of the fact that this is the obvious desire of all concerned, it may be expected that a large majority of governments will support this resolution when it comes up for discussion at the Conference.

Agreement on a multilateral treaty for scheduled as well as non-scheduled air traffic presents more of a problem.

The belief expressed at the last Strasbourg Conference that the airlines themselves could do a great deal to coordinate and rationalize their services often seems not to have been taken very seriously by the airlines. However, this is only apparently so. Cooperation other than under the auspices of I.A.T.A. is not very spectacular, though it is definitely efficient and valuable. Much is being done in the field of technical and operational cooperation, in respect of pools, etc. The "Air Research Bureau" in Brussels, which is an organization consisting of an ever-increasing number of European airlines, is an example. But under the system now imposed by governments the airlines cannot advance much further.

Governments will have to take action in the political, juridical, financial, administrative and fiscal fields. For example, in the political field regulations could be eased in granting commercial rights; the minimum would be to give greater freedom to airlines to obtain commercial rights themselves (e.g., the system of exchanging routes among airlines).

It is difficult to give a precise outline of any future multilateral treaty. But the first step is to recognize the basic issues and define the ultimate aims.

The basic issues: — To enable an airline to be a paying concern, and to give the public the best and lowest-priced service to which it is entitled. These are after all the generally accepted principles of a system of sound competition.

The common aims: — A common European policy under which each nation is first and foremost a part of Europe. Under such a policy it will be immaterial who performs a given task, as long as it is accomplished in the common interest of Europe. In this connection the interchange of routes and aircraft is becoming increasingly interesting.

The next Conference has it in its power to advance the European concept. It is to be hoped that this mission will be fully understood and that it will not be considered necessary to begin with measures of limited scope (e.g., Benelux, Iron and Steel Community) as a prelude to wider measures. Europe has a chance of setting an example to the rest of the world, an example which would convincingly prove that a choice has been made for a gradual liberalization of scheduled and non-scheduled civil aviation. Too many unsuccessful conferences have left the world little hope that the problem can be discussed in a really international spirit. But Europe is now in a position to take a decisive step towards curtailing petty national rights to decide by what airline passengers should travel and freight be carried. In *practice* this step would not mean any great sacrifice for European airlines: a recent study made by the French Institute for Air Transport (I.T.A.) shows that only 26 of 195 European routes touch more than two countries and that these 26 services carry only 10 per cent of the total traffic. A mere fraction of this 10 per cent is so-called Fifth Freedom traffic (traffic carried by a company between two foreign countries), which countries wish to reserve for their own airlines. This Fifth Freedom traffic, which in Europe is relatively modest and is further diminishing because of the increasing number of direct services, has hitherto been the great obstacle to the conclusion of a multilateral treaty. If this traffic were liberalized in Europe the road would be open to a European multilateral treaty which would have an extremely favourable effect on the rest of the world.

However, no restrictions designed to serve individual countries' national ends should then be imposed in respect of the routes to be flown. For in that case the victory of the international over the nationalistic concept would be nullified.

At the Strasbourg Conference of 1954 the British showed the way with their proposal, but unfortunately they turned it into an endless circle. Let us hope that the next Conference will be able to break this circle.

Summing up, there is a fair chance of the next Conference being a success in the freight field, as regards mail transport and perhaps in progressing towards multilateralism for scheduled and non-scheduled air traffic. Precisely because this possibility exists, failure of the Conference would be a sad blow to a world that has set its hopes on international agreement in many fields, including civil aviation.

Cooperation

BY WILLEM DESWARTE, MANAGING DIRECTOR OF SABENA, BRUSSELS

It can never be repeated too often that, in a world that must cooperate or die, I.A.T.A. is one of the few international organizations that has consistently performed its task of promoting world solidarity.

Among nations dedicated to political, social and economic separatism, it has succeeded—not by force, but through freely given unanimous consent—in weaving a unique network of air services, all governed by the same rates and the same high standards of safety and comfort. Moreover, it has achieved this by uniting airlines of all nationalities, some private, some State-operated, others of mixed economy, and has standardized the majority of technical and commercial operating rules.

Even in the traffic field, the natural ground for competition, air carriers have succeeded within a decade in constructing an organization perfectly adapted to the complexity of air transport. Hundreds of resolutions have been framed, though in many cases almost every word represents a compromise between views that at first sight had appeared quite irreconcilable.

The spirit of cooperation cannot be better illustrated than by the manner in which the rate structure has been worked out. To begin with, everyone had his own problem, in most cases determined by geographical conditions. Nevertheless, from meeting to meeting, and year to year, I.A.T.A. has gradually created a rate structure which takes everyone's interests into account. There have been complaints against its great complexity. This is undeniably a weakness, but is it not also a sign of this spirit of cooperation which set out to find a solution to the problems of each airline, to establish a general system acceptable to all, even if, because of its complexity, it is more onerous for each of those who prepared it to put into practice? However, it would now appear to be time to advance from the conciliation to the simplification stage.

In another domain, the standardization of conditions of carriage is also a comforting example of this spirit of cooperation. The problem here was not only to reconcile differing views, but also to draw up conditions that would fit into the various national legislations, some of them based on written law, some on precedent. If, at last, I.A.T.A.'s Legal Committee has been able to arrive at a text that, let us hope, can soon come into force, it is because all concerned have constantly looked beyond their company's immediate interest, in their conviction that standardization would improve the chances of development and the efficiency of air transport in general.

However, it is in the technical and operational field, where there is no spirit of competition to overcome, that there is the greatest scope for cooperation. Whether in the standardization of lighting or of training methods, or in the introduction of new navigation systems, I.A.T.A.'s Technical Committee and its sub-committees have been behind the remarkable results achieved lending I.C.A.O. a degree of assistance which the latter has readily acknowledged. If, on occasion, it seems to us in our efforts to defend our own interests, that we can never agree, we should remember these technical achievements.

Though problems of cooperation are handled in a satisfactory manner on the international level under I.A.T.A., the same cannot be said of regional cooperation, particularly in Europe.

The chief European I.A.T.A. members have long felt the need to create even closer ties among themselves in their various fields of activity. For example, K.L.M., Sabena and Swissair created the so-called "Beneswiss" agreements covering technical and operational cooperation, with exchange of experience, an attempt to standardize the equipment ordered, handling agreements, common technical servicing at landing points etc.... The original group has now been joined by Air France and S.A.S.

These same airlines have also set up the Société Internationale de Télécommunications Aériennes (S.I.T.A.) in Brussels, which provides its members, including a number of non-European airlines, with a high-density telecommunications network.

Finally, European airlines have formed a permanent committee known as C.P.A.M. (Common Purchase Aviation Material) to handle orders for equipment and spares placed in the United States.

These frequent contacts and the realization that there were other common preoccupations outside the technical or operational framework had already led to the foundation of the Air Research Bureau in Brussels in 1952. Members are Air France, B.E.A., S.A.S., Sabena, Swissair and K.L.M., who have recently been joined by Deutsche Lufthansa and Alitalia. The A.R.B. is a joint study organization, limited strictly to European airlines and open only to members of I.A.T.A., whose Director General takes part *ex officio* in the work of the committee.

Meanwhile, European governments have also more than once raised the question of coordinating air transport, both in the Council of Europe and through I.C.A.O. and O.E.E.C. These efforts, based of course on political considerations, led to the convocation of a European Civil Aviation Conference in Strasbourg in October 1954. The problems listed on the agenda had been studied by the Air Research

Bureau, who was able to furnish government delegations, through I.C.A.O., with accurate facts and figures.

Among the Strasbourg Conference's recommendations was the desire expressed by European governments to facilitate and encourage cooperation between airlines and to have an annual accounting of the progress made. It is for the latter purpose that a new conference will meet in Strasbourg next November.

It might therefore be thought that governments had found a valid instrument in the European Air Transport Conference, which would in the course of time solve the problem in a practical and constructive manner.

Nevertheless, a new approach to the same problem has just been attempted by the members of the European Coal and Steel Pool. A meeting of Foreign Ministers at Messina last June decided to call together in Brussels government experts in atomic energy, conventional forms of energy, transport and common markets, with the object of extending the Pool to these other domains.

The Transport Commission, which is of interest here, has created a Civil Aviation Sub-Commission, which in turn has formed a working group on which airline experts have been invited to collaborate.

At the time of writing, their advice has been asked on two special points: the creation of a European finance company for flying equipment, and the exchange of routes so as to improve the efficiency of the European network.

It seems to us that this move by the members of the European Coal and Steel Pool overlaps the efforts being made at Strasbourg and that it suffers from the grave defect of being much too limited in scope.

The European networks of K.L.M., Sabena and Air France are far from representing Europe's total domestic traffic. The absence of B.E.A., S.A.S. and Swissair limits the possibility of exchanging routes or concluding pool agreements to the point of insignificance.

It may perhaps be hoped that, as regards civil aviation, the framework of the Pool may eventually be expanded to embrace all the countries of Western Europe, but in this case we should merely have the same delegations as at the Strasbourg conference grouped round a different table.

Members of the Air Research Bureau

Eight European airlines form the Air Research Bureau, which has its offices in Brussels and is open only to I.A.T.A. member companies. Airlines 1 to 6 are those which founded A.R.B. in 1952, while airlines 7 and 8 joined later.

1 Air France,
2 rue Marbeuf, Paris

French national flag carrier

Capital: 10,000,000,000 francs
President: Max Hymans
Managing Director: Louis Lesieux

2 British European Airways,
Keyline House, Ruislip, Middlesex

Government-owned corporation for European services

Capital: £20,000,000
Chairman: Lord Douglas of Kirtleside

3 K.L.M. Royal Dutch Airlines,
Plesmanweg, The Hague

Dutch national flag carrier

Capital: 200,000,000 guilders
President: General I. A. Aler
Executive Vice-Presidents: F. van Balluseck, F. Besançon, M. J. van der Ploeg, Dr. L. H. Slotemaker

4 Sabena, Société Anonyme Belge d'Exploitation de la Navigation Aérienne,
35, rue Cardinal Mercier, Brussels

50% Government-owned

Capital: 300,000,000 Belgian francs
President: Gilbert Périer
Managing Director: Willem Deswarte

5 Scandinavian Airlines System,
Stockholm-Bromma Airport

50% Government-owned (Sweden-Norway-Denmark)

Capital: 157,000,000 crowns
President: Henning Throne-Holst
Managing Directors: Per M. Backe, Viggo J. Rasmussen

6 Swissair, Swiss Airlines,
Hirschengraben 84, Zurich

30% Government-owned

Capital: 14,000,000 Swiss francs
President: Rudolf Heberlein
Managing Director: Dr. Walter Berchtold

7 Alitalia, Aerolinee Italiana Internazionali,
20 Via Bissolati, Rome

Ownership:		
	Government	60.65%
	B.E.A.	20%
	B.O.A.C.	10%
	Private	9.35%

Capital: 4,500,000,000 lire
President: Count Dr. Nicolo Carandini
Managing Director: Bruno Velani

8 Deutsche Lufthansa,
Claudiusstrasse 1, Cologne

Chiefly government-owned (Federal and Land Governments)

Capital: DM 80,000,000
Chairman: Dr. K. Weigelt
Commercial Manager: Hans M. Bongers

Moreover, it looks as if the authors of this new move were acting in ignorance of the Air Research Bureau's work, under the leadership of Professor de Groote, former Belgian Minister for Economic Coordination and a transport expert. It is the conclusions reached by the Bureau that have inspired the careful, and hence constructive, attitude of the governments assembled at Strasbourg.

Professor de Groote showed perfectly objectively that the weakness of the European network arose essentially from the low frequency of air services and that the latter was due in the main to Europe's highly developed ground transport system and to the low average income level of its population.

In fact, the European network is far more concerned with collecting and distributing long-distance passengers than with providing real inter-European services. Unless non-profitable services are to be developed, and hence the chronic deficits of Europe's short-distance transport operators to be still further increased, only the expansion of traffic as a whole, and primarily inter-continental traffic, can lead to what Professor de Groote calls "auto-coordination".

The essential mission of governments is to encourage any initiative that meets economic needs or potentials. They should not supplant private initiative or apply coercion to it unless it breaks down. The latter certainly does not apply to the European airlines, who have proved their capacity and their desire to cooperate, both within the framework of I.A.T.A. and within the European framework.

It is to be feared that the effort to improve cooperation between certain European airlines may merely compromise the results of the wider cooperation that already exists between the airline members of A.R.B., whose work, as already stated, deals precisely with the questions of coordination discussed by the Strasbourg Conference.

Although it is difficult to predict the outcome of the next session, it may yet be hoped that, thanks on the one hand to the creation of a basis for collaboration between the conference and A.R.B. and on the other to the preparation of a basic outline for a multilateral agreement, cooperation between European airlines may be harmonious, to the benefit not only of the European traveller but also of the whole I.A.T.A. family.

Air Transport

Silver Jubilee of Air France's South Atlantic Route

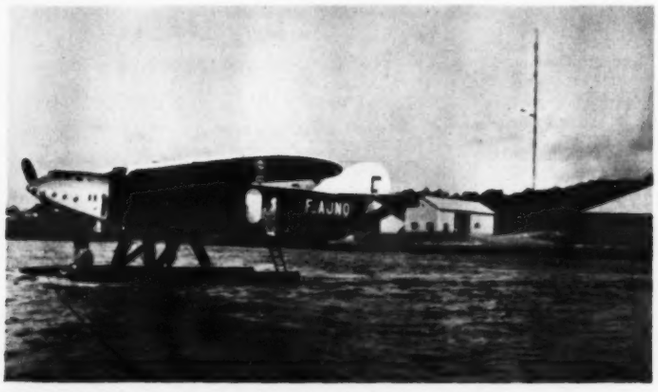
BY INTERAVIA'S PARIS CORRESPONDENT

The crew of the Latécoère 28 which made the first commercial South Atlantic crossing twenty-five years ago: Dabry, Mermoz and Gimié.

"We were flying so low that a wave tore away the aerial," Jean Dabry, today one of Air France's senior skippers, twenty-five years ago the navigator on the Mermoz-Dabry-Gimié team which made the first commercial South Atlantic crossing on May 12th, 1930—was telling us on May 12th last as we sat in the comfortable seat of the *Super Constellation* flying Air France's Silver Jubilee schedule and the company's 19,036th crossing to South America.

"Things have changed a lot. The first time we flew the whole way at heights between fifty and two hundred meters, for three hours of the crossing in pitch darkness. After the aerial had gone, Gimié fitted another, but we never succeeded in contacting Aéropostale's picket boats. It was stifling hot and we were buffeted about, and finally it began to rain as it can rain only in those parts. The cockpit was full of water and we felt as if we were sitting in a Turkish bath. Twenty-one hours after taking off from Saint-Louis in the Senegal we set the Latécoère 28 seaplane down on the Rio Potingui . . ."

And what did you do then?



The Laté 28 of Dabry, Mermoz and Gimié: "Le Comte de la Vaulx".

"Well, we had a meal, drank a little champagne and went to bed. We needed that sleep. Our mail load of 130 kilograms was picked up by Raymond Vanier, today the manager of the French domestic night air mail system, who flew it down to Recife, Maceio, Bahia, Caravellas, Victoria and Rio. Reine and Guillaumet carried it onwards to Buenos Aires and finally across the Andes to Santiago de Chile . . ."

Our *Super Constellation* lands at Galeao airport, Rio de Janeiro, exactly 23 hours 37 minutes after starting from Paris-Orly.

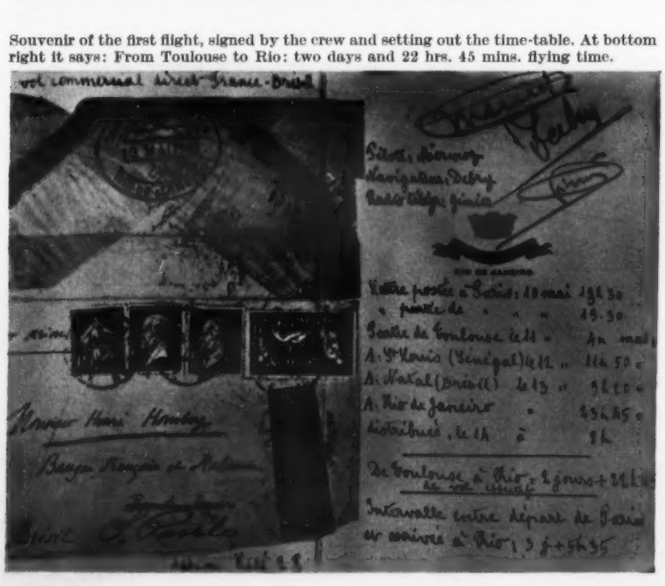
At the origin of it all was Pierre Latécoère, industrialist of Toulouse, who in September 1918 proposed to the French Government to establish a commercial air link between France and South America—no less. With war surplus aircraft a small group of pioneers set to work, and on September 1st, 1919, they accomplished the first mail flight from Toulouse to Rabat in Morocco.

There followed the establishment of the Casablanca-Dakar leg, across a thousand miles of territory inhabited by dissident tribes. Engines had a short life, aircraft were not very reliable. So it was decided to send out two aircraft at a time, and when one of them started shedding its pistons and connecting rods the other set down beside it and took over its mail. And the pilot waited for rescue next to his disabled machine. Very often the Moors and other rebellious tribes got there first, looted the aircraft, killed or captured the crew. Marcel Reine, for example, spent 117 days in slavery before being released for ransom money.

Today it takes 32 hours to fly from Paris to Buenos Aires. You sleep in a bed like at home, you eat as in one of the finest restaurants of Paris.

There is a marble tablet in the courtyard of the French Hospital in Buenos Aires, dedicated "To the Martyrs of the France-Argentina Air Route". It bears 119 names . . .

Souvenir of the first flight, signed by the crew and setting out the time-table. At bottom right it says: From Toulouse to Rio: two days and 22 hrs. 45 mins. flying time.



A Latécoère 28 landplane over the Bay of Rio de Janeiro.

Turbine Air Transportation one Step over the Threshold

A Critical Review of Papers Presented at the Seattle Meeting of the Institute of the Aeronautical Sciences, August 8–10, 1955

BY MAURICE A. GARBELL, D. Sc.
PRESIDENT, MAURICE A. GARBELL, Inc., AERONAUTICAL ENGINEERS AND CONSULTANTS
AND
GARBELL RESEARCH FOUNDATION, SAN FRANCISCO

Turbine air transportation is becoming a reality. For most of the post-war years, while the military turned almost exclusively to the turbine-driven aircraft, civil air transportation depended entirely on the accelerated development of high-performance piston-engine aircraft. Today the growing requirements for higher speeds by the airlines are at last being met by the continued improvement in economy and dependability of the turbine powerplant. The curtain now rises on a stage set for a significant penetration of the gas turbine into the field of civil air transportation.

THE MAIN THEME — TURBOJET VERSUS TURBOPROP

Assuming ready availability of turbine engines of all desired types, the main theme of the Seattle Conference revolved around the question of "turbojet or turboprop".

Reduced to its simplest terms, the comparison may be stated as follows:

	Turboprop	Turbojet
Cruising speed	350 knots	450 knots
Block speed	250 knots	350 knots
Cost/ton mile	100 percent	150 percent

This somewhat simplified comparison leads to questions such as, "When 'A' line starts selling premium tickets for its blue-ribbon turbojet express, will 'B' line manage to survive with its less glamorous turboprop-liner, even at lower fares?"

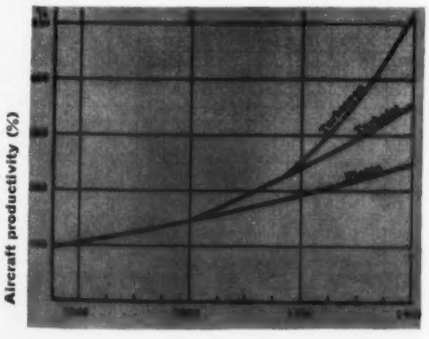
To this question the writer might point out that high-speed/high-cost flights and low-speed/low-cost flights operate side-by-side today, with no harmful unbalance apparent either way. Only during the initial period of a new service, be it a new coach schedule or an especially attractive first-class "super bomb shell", is there a temporary surge of passenger preference toward the newcomer, soon stabilized when the pros and cons of speed and cost are fully recognized and weighed by the public. Ultimately, the customer chooses that service which best meets his particular need.

Yet, upon closer scrutiny, the problem is found to be far more complex than would appear from the aforementioned comparative simplification. The countless intertwined considerations and evaluations with which the commercial operator is concerned when selecting the most suitable type of aircraft for his particular requirements, were presented at Seattle, in a scholarly paper by Mr. C. H. Jackson, of B.O.A.C.[1]

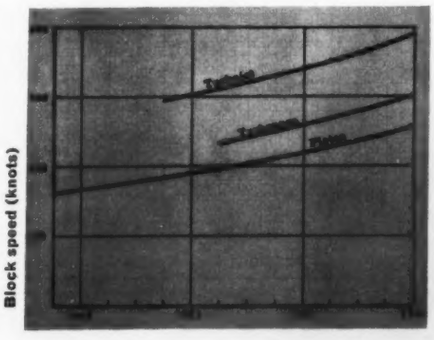
In Mr. Jackson's opinion, the significant increase in productive capacity of turbine-engine aircraft, by reason of their higher speeds and greater load capacity, makes the correct matching of fleet productive capacity and anticipated volume of traffic particularly important. He anticipates a steeper rate of revenue earnings versus load factor on future turbine aircraft than on today's piston-engine aircraft, and hence both a greater reward for exceeding

[1] *Technical Development and the Commercial Requirement.* C. H. Jackson, Manager, Operations Development Unit, British Overseas Airways Corporation.

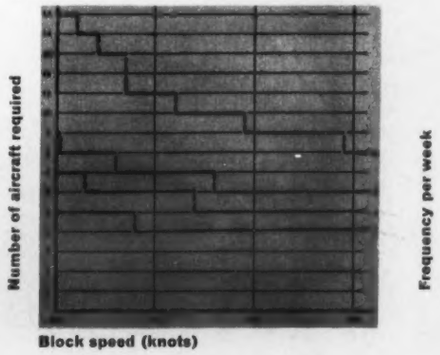
Probable growth in commercial aircraft productivity between 1947 (= 100 %) and 1960, according to C. H. Jackson (B.O.A.C.). Productivity is defined by Jackson as the product of payload capacity (in ton-knots) times block distance (nautical miles) divided by take-off weight (tons), and is thus equal to nm²/hr.

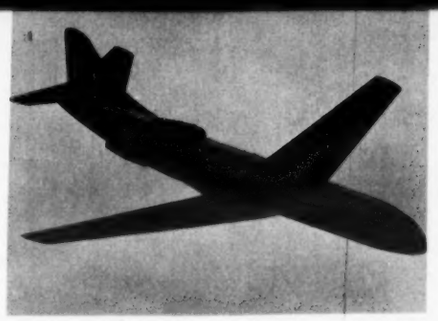


Observed and probable development of average block speed in piston-engined, turboprop and turbojet commercial transports from 1947 to 1960, according to C. H. Jackson (B.O.A.C.).



Number of aircraft required (left-hand ordinate) to maintain a given weekly frequency (right-hand ordinate), versus block speed in knots *(abscissa)*, according to C. H. Jackson, of B.O.A.C.'s Operations Development Unit. Above 250 knots relatively large increases in speed are needed to save even a single aircraft.





Main subject of the I.A.S. meeting in Seattle was "Turbojets versus turboprops". France's S.N.C.A.S.E. SE. 210 *Caravelle* twin-jet medium-stag etransport, now undergoing tests, and Britain's Vickers *Viscount* turboprop medium-stage transport (here in T.C.A. colours), already in service with a number of airlines.

the break-even load factor and a costlier penalty when not attaining it. The improving fuel economy of turbine engines, meanwhile, will lower the break-even load factor.

Increase in aircraft productivity, according to Mr. Jackson, may lead to smaller fleets without, however, any loss in trip frequency, provided that highest utilization is attained through improved scheduling and operational methods.

From his analyses of block speeds, fleet sizes, trip frequency and aircraft utilization, Mr. Jackson estimates that at the higher block speeds, say above 250 knots, very large increases in speed (for a given traffic volume) may be required to reduce a given fleet by a single aircraft and thereby improve the utilization of the fleet and reduce operating costs. At this point the selection of turbojet versus turboprop may become extremely difficult, because the added speed of the turbojet might incur excessive cost, if the speed increment over the turboprop does not yield an aircraft productivity increment large enough to justify a reduction in fleet size.

Mr. Jackson deduces that, when the respective characteristics of either powerplant are utilized to full advantage, there is a place for either type on long-haul routes. He prefers jet-propelled aircraft for express operations on long routes with limited en-route traffic potential, but foresees an efficient and cheaper, though slower, turboprop service, especially where its economic and operational characteristics might permit more devious routings to serve additional traffic-generating centers en route.

Also anticipated by Mr. Jackson are subsidiary advantages for airline economy from turbine-driven aircraft. For example, the availability of power and bleed-off air for boundary-layer control should improve take-off, final approach, and landing characteristics and afford greater punctuality in operations—elements which contribute both to passenger good will and to higher aircraft utilization.

For the more distant future, he foresees vertical take-off aircraft on "local" routes, supersonic transports on high-speed high-density routes such as the North Atlantic, and subsonic aircraft with drag-reducing boundary-layer control on those routes where the ultimate in economy and low fares is an essential.

COMMERCIAL TURBINE-DRIVEN AIRCRAFT OF THE PRESENT AND THE IMMEDIATE FUTURE

All present turbine-driven aircraft are designed uncompromisingly around existing types of engines. Some aircraft designs provide for future installation of more powerful engines, but all are outgrowths of given engine specifications. Co-operative design, wherein powerplant and aircraft are each designed to afford the best possible overall configuration, is not yet at hand. The preponderance of the powerplant in the design of turbine aircraft was emphasized in all the sessions.

● The Vickers Viscount — Experience of Trans-Canada Air Lines

The first Canadian experience, covering 9,000 aircraft hours of operation of the Vickers *Viscount* (since December, 1954) was reported at Seattle by Mr. J. T. Dyment of T.C.A.[2]

The T.C.A. *Viscounts* are powered by four Rolls Royce R.Da. 3 *Dart* engines, Mk. 506 version, which incorporate internal flow improvements yielding superior cruise performance. Since take-off power is not critical in T.C.A. operations, T.C.A. adopted the lighter reduction gear of the Mk. 506 at the cost of a slight limitation in sea-level take-off power.

Mr. Dyment reports that the Vickers aircraft has met or exceeded every contract guarantee, and that the aircraft has caused less troubles than any other new type of airliner. The following specific comments are interesting to note.

The *Viscount* is a one-man airplane (either from the left or from the right seat); there are 145 less items (controls, indicators, and warning lights) to look after than on comparable piston-engine aircraft.

Cruising speed is 275 knots at 20,000 feet (2 knots better than promised). Fuel consumption is as anticipated. Consumption of water-methanol for take-off power restoration on hot days is as specified, but only if the tailpipe temperature elements governing its injection are maintained and calibrated with absolute laboratory accuracy.

Maximum payload (11,625 lb; 625 lb above contract guarantee) allows for 700 nautical miles flight, plus 260 nautical miles for diversion, plus 1 hour's holding at 5,000 feet. Practical payload, with 40 comfortably seated passengers, is about 10,200 lb.

The overall noise level within the fuselage is 104 db in the plane of the propellers, 83 db along the front row of passenger seats; the noise level in the 1,200—2,400 cps "speech-interference" spectrum is 50—70 db throughout the cabin. External noise at take-off, 112 db at a distance of 125 ft, has been found acceptable by both London Airport and the Port of New York Authority. Taxiing noise (with "whistling" frequencies predominating) is highly directional and no louder than that of present piston-engine aircraft.

After engine starting (35—60 seconds), T.C.A. taxies the *Viscount* on the two inboard engines at 10,000 rpm, with outboard engines idling. When cleared for take-off, tailpipe temperatures are briefly checked at 12,000 rpm, and take-off performed at 14,500 rpm. Climb and cruise are at 13,600 rpm; initial approach at 11,000 rpm and 140 knots equivalent airspeed; final approach at 120 knots; "over the fence" at 105 knots. After touchdown the propellers are automatically set to a "ground fine" blade setting of 8 degrees. Coupled with the use of Dunlop Maxaret non-skid brakes, the propeller drag is fully adequate for short stops, even on ice. Mr. Dyment finds no need for reverse-pitch propellers.

Principal subjects of passenger satisfaction expressed to T.C.A. are low noise level and large windows.

● The SE.210 Caravelle

Technical details of the SE. 210 *Caravelle* are published elsewhere in this issue. The Seattle presentation by M. Lecarme[3] adds the following points of interest:

The SE. 210 design was based on a 1951 specification by the French Government for a medium-range jet capable of carrying a 12,000—14,000 lb payload over 1,000 nautical miles at a 350-knot block speed. Actually, the

[2] *Operational Experience with Turbo-Prop Powered Transport Aircraft.* J. T. Dyment, Director of Engineering, Trans-Canada Air Lines.

[3] *Considerations on Design and Development of SE.210 Caravelle.* Jacques Lecarme, Technical Adviser and Test Pilot, and Jean P. Gelos, Airlines Technical Relations Engineer, Société Nationale de Constructions Aéronautiques du Sud-Est.

aircraft carries a payload of 20,900 lb over 1,145 nautical miles (including a 12 percent reserve, plus 160 nautical miles diversion, plus 30 minutes holding at 5,000 feet) at a cruising speed of 428 knots. Gross weight is 90,000 lb, design Mach number is 0.75.

S.N.C.A.S.E. had little hope of competing in the piston-engine field dominated by several U.S. types, and the field of the medium turboprop airliners appeared pre-empted by the Vickers *Viscount*. Dependable larger turboprop engines were not available. While France could not procure turbojet engines from the United States, the Rolls Royce *Avon* (10,000—12,000 lb thrust) was obtainable.

The two-engine configuration with lateral fuselage pods was selected because: (1) It resulted in a clean wing, with uninterrupted flaps and an efficient structure; (2) The intake ram-efficiency of the engines is substantially constant with angle of attack and angle of sideslip; (3) Downwash changes due to angle of attack and flap deflection are small and are counteracted by the pitching velocities during turns and nose-up manoeuvres; (4) Alignment of the thrust with the center of gravity, accomplished in part through skewed cut-offs of the tailpipes, minimizes yaw with one engine inoperative and during reverse-thrust operations; (5) Low fuselage height above the ground facilitates loading, yet sufficient height of engine intakes (and protection by the wing) minimizes foreign-object damage; (6) Engines are behind the pressurized cabin, therefore even a turbine-wheel failure would not cause sudden decompression; (7) In the event of a crash landing, the engine location minimizes danger of fuel fires and hazard to passengers; (8) Engine position facilitates quick engine change; (9) The noise level in the cabin is uniformly low, and pilots can converse without use of an intercom.

The SE. 210, to date, has flown at speeds up to M = 0.83 at 30,000 feet, and, according to Messrs. Lecarme and Gelos, has fulfilled every expectation.

● The Fokker F-27 Friendship

The design philosophy underlying the Fokker F-27 project was critically examined in a paper by Engineer H.C. van Meerten[4].

The Fokker F-27 is explicitly intended to serve as a modern successor to the seemingly imperishable DC-3. Fokker concluded, after an examination of the three possible types of powerplant, that the turboprop is more efficient than the turbojet over the desired short ranges, and that the difference in installed powerplant weight afforded a substantial margin in favor of the turboprop over the piston engine.

Van Meerten showed a comparison between the turbine-powered F-27 and an imaginary piston-engine powered aircraft of equivalent performance.

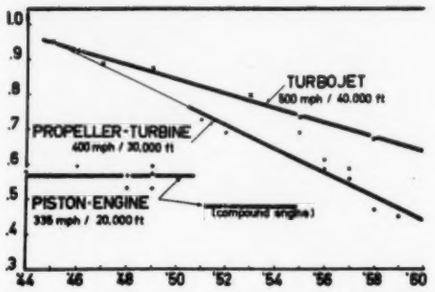
	F-27 Turboprop	Alternate Piston-Engine Aircraft
Weight Empty	21,685 lb	26,550 lb
Gross Weight	34,200 lb	38,400 lb
Cruising Speed	238 knots at 20,000 feet	212 knots at 15,000 feet
Design Block Speed	208 knots	181 knots
Cost, $/ton. mile based on S.B.A.C. method	0.122	0.151

The piston-engine aircraft manifests a 25-percent higher cost per ton-mile than the turboprop F-27. Examination of hot-day take-off and one-engine-inoperative climb reveals that the turboprop engine with water-methanol injection in take-off is far superior to the piston engine.

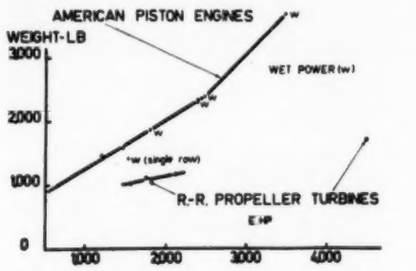
● The Douglas DC-8

The new Douglas turbojet aircraft is now in production, according to Mr. Ivar L. Shogran[5]. There will be no prototype; Douglas Aircraft Company considers its experience, both with heavy propeller-driven transport aircraft and with high-speed military turbojets, sufficient to justify the accelerated production effort.

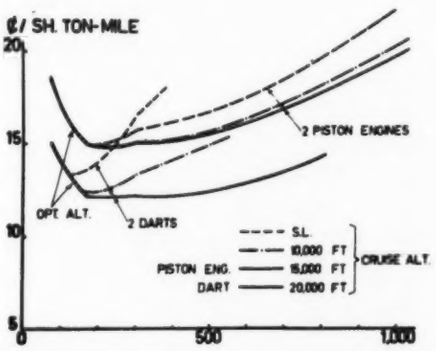
The position of the DC-8 aircraft in the Douglas family of commercial aircraft is shown in the following two comparison tables:



Observed and probable development of specific fuel consumption for turbojet, propeller turbine and piston or compound engines, from 1944 to 1960, according to H. C. van Meerten, Royal Netherlands Aircraft Factories Fokker.

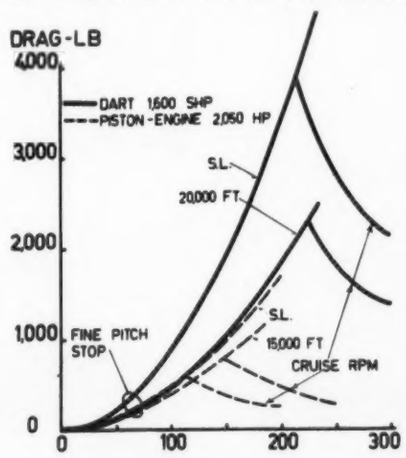


Weight comparison (in lbs) between modern American piston engines (top) and British propeller turbines (bottom) versus take-off power, according to H. C. van Meerten. Power given is "wet" take-off power (with water-methanol injection) in the case of the piston engines, and maximum equivalent shaft horsepower in that of the turboprops, both in h.p.



Comparison of direct operating costs (in cents per short ton-mile capacity) for twin-engined turboprop and piston-engine aircraft at different altitudes, according to H. C. van Meerten. Block distance in statute miles is entered on the abscissa.

Comparison of windmilling drag (in lbs.) for typical turboprops (unbroken lines) and piston engines (broken lines) versus speed (knots), according to H. C. van Meerten. The high windmilling drag of idling turboprops shortens the landing run but may have highly undesirable results in flight, e.g., in the event of fuel difficulties.



Artist's impression of the Fokker F-27 *Friendship* turboprop airliner.

[4] *Characteristic Qualities and Design Problems of the Fokker F-27 Twin-Propeller Turbine Transport.* H. C. van Meerten, Deputy Director and Chief Engineer, N. V. Koninklijke Nederlandse Vliegtuigenfabriek Fokker.

[5] *Economics of the DC-8.* Ivar L. Shogran, Chief Project Engineer, DC-8 Series, Santa Monica Division, Douglas Aircraft Company, Inc.

Douglas Aircraft Types	DC 3	DC 4	DC 6	DC 7	DC 8
Cruising Speed, knots	156	200	269	313	481

	DC-7	DC-8 Domestic	DC-8 Overwater
Length	112'3"	140'6"	140'6"
Height	31'8"	40'2"	40'2"
Maximum Take-off Gross Weight	140,000 lb	211,000 lb	257,000 lb
Fuel	7,860 gals.	13,338 gals.	18,538 gals.
Passengers	76	103	125
Cargo Space	651 cu.ft.	1,253 cu.ft.	1,253 cu.ft.
Wing Area	1,637 sq.ft.	2,594 sq.ft.	2,594 sq.ft.
Wing Span	127'6"	134'6"	134'6"
Sweepback (0.25 c)	—	30 °	30 °

The main landing gear of the DC-8 comprises two twin wheels that retract into the wing-fuselage junction in a skewed attitude. The landing gear permits swivelling on a strut, to conserve ramp space.

The passenger cabin is equipped with two doors, front and rear, for faster loading and to facilitate two-class cabin arrangements.

According to calculations based on the 1949 Air Transport Association method, plus 20 percent, and assuming an 8-year depreciation and a 26-cent/gal. fuel cost for the DC-7 and a 10-year depreciation and a 20-cent/gal. fuel cost for the DC-8, Mr. Shogran arrives at a direct operating cost for the DC-7 coach of 1.7-cent/200-lb. naut. mi. (for ranges between 1,000 and 3,000 nautical miles) and for the DC-8 of 1.3-cent/200-lb. naut.mi. (for ranges between 1,000 and 3,700 nautical miles). Even for the shortest distances, such as New York—Washington and Los Angeles—San Francisco, Mr. Shogran anticipates economic advantages of the DC-8 over the DC-7.

Take-off and landing lengths of the DC-8, according to Mr. Shogran, will be substantially the same as those of the DC-7, with increments of about 300 feet for high-temperature days.

● The Boeing 707

A panel of Boeing Engineers[6] discussed both the accomplishments and the problems of the Boeing 707 flight test program up to the present hour.

A total of 190 hours' flight testing, of which 80 hours were devoted to aerodynamic problems, have brought the aircraft to complete readiness for production.

Handling characteristics at low speeds are reportedly excellent, with an "honest" stall, beginning at 10—12 knots above stalling speed and developing from a mere tremor to strong buffeting. Adequate lateral control, through ailerons combined with spoilers, is had at all speeds, down through the stall. The control forces of this highly manoeuvrable aircraft are said to be comparable to those on the DC-7 (one-hand control at all speeds). Even with a complete hydraulic failure the aircraft remains flyable, since all controls except the spoilers are actuated manually.

The dorsal wing spoilers and the landing gear serve as drag brakes, resulting in safe rates of descent up to 12,000—14,000 fpm without unduly high forward speeds.

Engine acceleration from idle to rated thrust is possible within less than 5 seconds.

The aircraft has been flown to its placarded Mach number and equivalent airspeed. The $V_{e_{max}}$ flights required a 15-degree full-power descent from 45,000 ft to 37,000 ft; the ensuing slight longitudinal trim change due to compressibility was readily trimmed out with the adjustable stabilizer. High-Mach turns were made on ailerons alone.

The high-Mach warning consists of an audible air noise, a slight (1/16") lateral control nibble, and a slight buffeting resulting from initial wing boundary-layer separation.

Landing attitude is normal. After touchdown, a rapid nose-down to three-point attitude and extension of the dorsal spoilers produce a heavy load on the wheels and make effective wheel braking possible. In addition, reverse thrust is available.

The prototype was flown generally at 160,000—190,000 lb, and commercial gross weights of 210,000—250,000 lb are foreseen for the immediate future. Yet, according to Boeing design engineer Don Finley, com-

[6] *Boeing 707 Program, Progress Report.* George C. Martin, Chief Engineer. Boeing Aircraft Company, assisted by a panel of four Boeing Engineers.

Artist's impressions of two commercial transports under construction for the coming decade: left, the Lockheed *Electra* with four turboprops (for longer medium stages), right, the four-jet Douglas DC-8 (long stages).

Models of a projected commercial version of the Boeing 707 for 108 passengers. Nose carries radar for storm warning and map painting.

mercial gross weights of 250,000—280,000 lb, military gross weights of 240,000—300,000 lb, and tanker gross weights of up to 390,000 lb are foreseen, with powerplants yielding twice the thrust of the present Pratt & Whitney JT-3 turbojets (commercial equivalent of J-57).

Incidentally, history may record that on Sunday, August 7th, 1955, in a spirit of good, clean fun, the Boeing 707 prototype performed a spectacular slow roll in full view of virtually all gaping Seattle and the assemblage of spectators and television cameras at the Gold Cup power-boat races on Lake Washington.

OUTLOOK FOR THE FUTURE

● The Impact of Turbine Aircraft on the Air Traffic Control Problem

"No special privileges; no special consideration. Full compatibility of civil turbine-driven aircraft with piston-engine aircraft throughout the air traffic control system." That is the essence of tentative conclusions expressed by Mr. Charles W. Carmody of C. A. A.[7].

Each phase of a typical flight was examined, and in each instance Mr. Carmody endeavored to explode what he termed the "old wives' tales" on how the lowly-born piston-engine aircraft would have to halt operations and wait in a corner, whenever the exalted turboliner chose to cut across all available lanes of traffic on its unalterable optimum flight path.

Mr. Carmody contends that the insistent requirements of the airlines have already induced aircraft designers to exercise their ingenuity towards making future turbine airliners fully compatible with all other air traffic. Representatives of Trans-Canada and Douglas Aircraft Company, among others, upheld these statements with emphasis.

The views of the Civil Aeronautics Administration, as expressed by Mr. Carmody, are summarized in the following condensation:

On the Ground. Loading at the gate should be feasible; blast effects are not expected to be excessive. Waiting at the gate for take-off clearance is impractical for two reasons: (1) Busy airports cannot spare gate positions that long; (2) By-pass taxiing to the runway, past piston-engine airliners waiting for their take-off clearances, is physically impossible at many airports and would be psychologically irritating in any event. Mr. Carmody proposes taxiing on one engine and starting the other engines on air bleeds from the first engine when cleared for take-off.

Take-Off. Turbine aircraft spend even less time on the runway; take-off lengths and footprint pressures are comparable to those of present airliners.

Climb. While normal climb operations of turbine-driven aircraft do not present any special problem, Mr. Carmody concedes that any requirement for temporary leveling off or any other delay in reaching cruising altitude will result in high fuel consumption. This, in the writer's view, is one of the most serious problems in the control of turbine-driven aircraft, since an excessive fuel consumption at the beginning of a long-distance flight cuts into the reserve which might possibly be required for unforeseeable delays in the later stages of the flight.

Descent and Terminal Area. Mr. Carmody contends that holding speeds currently contemplated by manufacturers are excessive for the narrow holding patterns available in metropolitan areas; rates of descent are inadequate. He visualizes that an "ideal" aircraft be capable of holding at 155 knots equivalent airspeed and of descending at 5,000 fpm or more. Low-level holding should be possible, since fuel consumption at holding power is only 10—15 percent greater at 5,000 ft. than at 20,000 ft. altitude.

Final Approach and Landing. Turbine aircraft are perhaps better than piston-engine aircraft. Rapid deceleration after touchdown is assured by "flat-pitch" propellers on turboprop aircraft, reverse-thrust devices on turbojet aircraft, and non-skid brakes on both. In "wave-offs", twin-spool turbojet engines will outaccelerate present piston engines.

Air Traffic Control Aspects. Mr. Carmody does not labor under any delusion that today's air traffic control system is adequate to absorb the added traffic of future turbo aircraft. His thesis is that an air traffic control system must be developed which will expedite the movements of *all* aircraft, regardless of powerplant, but that it must be an efficient *single-class* system and not an involved *two-class* system with high-priority aristocrats and underprivileged workhorses. He cites dual runways, adequate warm-up pads and by-pass areas, arrival and departure control by radar, dependable *rho-theta* navigation, accurate altimetry, improved aircraft electronics and control of all airspace at high altitude among the many elements of air traffic control that require foremost attention and competent development, in order that both the turbine and the piston-engine aircraft may operate in an efficient single-class air traffic control system.

[7] *Effect of Civil Turbine-Powered Aircraft on the Air Traffic Control System.* Charles W. Carmody, Chief, Operational Procedures Branch, Civil Aeronautics Administration, Washington, D.C.

Category	Anticipated Number of Aircraft	Gross Weight 1,000 lb	Number of Passengers	Cruise Speed knots	Range nautical miles	Type of Propulsion	Unit Cost $ 1,000	Existing Aircraft Types or Designs
Long Range Blue-Ribbon Express	200	300	100	450	3,500	turbojet	6,000	Boeing 707, Douglas DC-8
Long Range Low Cost	400	180	100	350	3,500	turboprop	3,500	Bristol *Britannia*, Lockheed Turboprop *Super Constellation*
Medium Range High Speed	100	150	70	450	1,750	turbojet	2,500	De Havilland *Comet IV* S.N.C.A.S.E. *Caravelle*
Medium Range Low Cost	500	100	70-90	350	1,750	turboprop	2,000	Lockheed *Electra*, Vickers *Viscount* Development
Medium-Short Range Low Cost	400	65	50-60	300	1,200 E	turboprop	1,000	Vickers *Viscount 800 Series*
Short Range Low Cost (DC-3 Successor)	600	35 E	30	220	500-800 E	2 turboprops plus booster jets or 4 small turboprops	400	Fokker F-27
Multi-Engine Helicopter	500	60	50	130	200 E	2 or 4 turbine engines	1,500	None yet

E = author's estimate

● Peter G. Masefield and His Crystal Ball

The entire Seattle Conference received considerable lift and propulsion from the seasonings, salted and peppery, liberally sprinkled on its proceedings by Mr. Peter G. Masefield, Chief Executive of British European Airways, the Guest of Honor. While he appeared to enjoy himself hugely throughout the technical sessions, and even more in the discussion which followed each paper, he took a serious look into the future as the Principal Speaker at the Banquet Dinner, when presiding officer Mr. Wellwood E. Beall, Senior Vice-President of Boeing Aircraft Company, firmly set a microphone and a "crystal ball" before him. Mr. Masefield foresees great things for the period from 1958 to 1966, as condensed by the writer in the above tabulation. From past experience, Mr. Masefield's crystal balls project readings that may seem somewhat high at the time of a forecast, but have proved to be conservative indeed when the unfoldments are viewed in retrospect.

New Aircraft for Short and Medium Stages

Once again the papers read at the Seattle Meeting, and in particular the forecasts of B.E.A. Chief Executive Peter G. Masefield (see table above) show clearly how radically performance standards in world air transport have changed with the technical progress of the past ten years. Aircraft for ranges of 1,730 to 2,000 nautical miles, such as the Lockheed *Electra* and S.N.C.A.S.E. *Caravelle,* are today described as "medium-stage transports," and even the new de Havilland *Comet 4* (max. operating range 2,350 to 2,560 nautical miles with full load) now falls into this category. Take-off weights of 30 to 70 tons, and hence wing loadings of around 70 lbs./sq.ft. are accepted without question in any "normal" medium-stage aircraft, and seating capacities for 50 to 70 passengers are a "must". The development of ever-increasing range and passenger accommodation and—inevitably—ever-rising purchase price has only one snag: the lower limit for economic operation of these aircraft is around 270 nautical miles, given an adequate load factor.

The only "real" long-stage aircraft left are thus those few with extremely long range which can, for example, cross the North Atlantic nonstop—namely the Douglas DC-7, Lockheed *Super Constellation,* Bristol *Britannia* and perhaps still the Boeing *Stratocruiser*. These will doubtless be joined within the next few years by the Douglas DC-8 and Boeing 707 super-heavy jet transports . . . with take-off weights of 100 to 136 tons. Meanwhile, aircraft hitherto classed as long-range types are being used to an increasing extent on clearly medium stages, for example the Douglas DC-6B on Swissair's Zurich—London route or the Bréguet *Deux-Ponts* on Air France's Paris—Marseilles—Algiers service.

At the lower end of the block distance scale, in the short-stage range of 80 to 220 nautical miles, the aircraft will have to meet a powerful competitor in the helicopter. True, as long as there are fully-depreciated DC-3s available for these distances and twin-engined helicopters cost a fortune and are not fully proven, the fixed-wing aircraft will remain clearly in the advantage. But how much longer will this reprieve last? Even the longest-lived aircraft must eventually retire. On the other hand an economic commercial helicopter may not be available for another few years.

The types of aircraft that will be used as "stop-gaps" will depend firstly on the traffic volume on the routes in question and secondly on initial purchase price and total operating costs. On short stages with regular, high traffic volume, for example between Stockholm and Gothenburg (250 miles) or Zurich and Geneva (140 miles), the Convair 240 or 340 (40 or 44 seats) could replace the DC-3 (26/32 seats) and at the same time cut airport-to-airport travel time by one third. In recent weeks no fewer than 26 aircraft of a modernised version of the Convair Liner for 48/52 passengers—type designation *Convair 440 Metropolitan*—have been ordered by S.A.S., Sabena, Swissair, Real and Finair . . . specially for short-distance operations.

(Continued on page 769)

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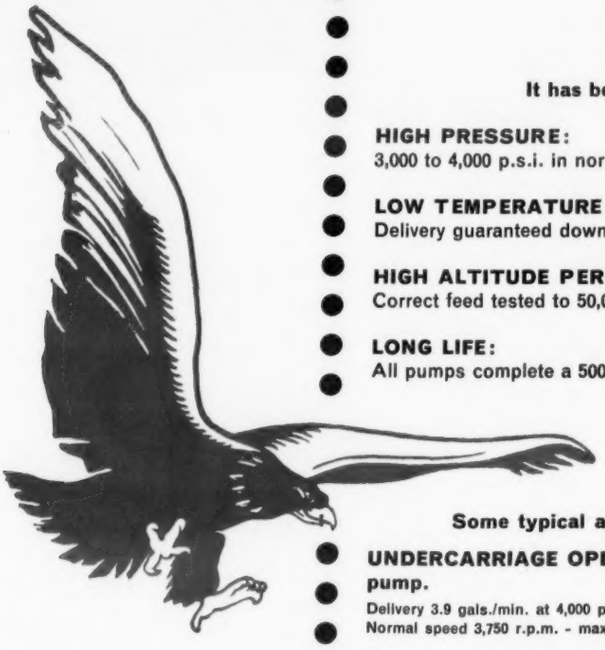

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Normal speed 6,850 r.p.m. - max. speed 7,100 r.p.m.

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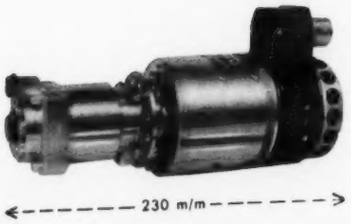
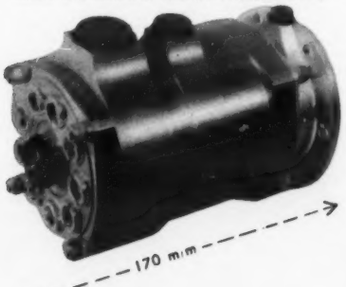


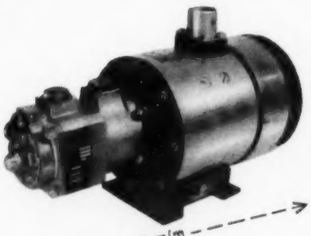
230 m/m

Electric pump
Delivery 0.5 gals./min. at 4,650 r.p.m.
under a pressure of 1,920 p.s.i. (Mystère IV)



170 m/m

Self-regulating pump
Delivery 5,3 gals./min. at 3,750 r.p.m.
under a pressure of 3,000 p.s.i.



340 m/m

Electric pump
Delivery 0.9 gals./min. at 6,850 r.p.m.
under a pressure of 3.000 p.s.i. (Fouga 170 S)

170 m/m

Self-regulating pump
Delivery 0.9 gals./min. at 6,850 r.p.m.
under a pressure of 3,000 p.s.i.

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(Continued from page 764)

On short and medium routes with low or sharply varying traffic volume, in particular where economic operation can be obtained only through mixed passenger and cargo services, there are good prospects for other DC-3 replacement candidates. Here the decisive factor will probably be the purchase price of these new aircraft. When it is considered that many of the veteran DC-3 now in service were bought for around $ 50,000 (plus conversion costs), while the new Convair 440 costs about $ 700,000, the broad economic field open to the new generation of aircraft can be clearly discerned. At least four aircraft manufacturers have recognized their opportunity and worked out designs of very varying configuration, most of which are already being tested:

— Fokker F.27 *Friendship* (up to 36 passengers);
— Aviation Traders *Accountant* (up to 36 passengers);
— Hurel-Dubois HD.32 and HD.321 (44 passengers);
— Handley Page *Herald* (up to 44 passengers).

All these new types are described in the following pages, as are also, to round off the picture, commercial transports for very long medium stages—de Havilland *Comet 4*, S.N.C.A.S.E. *Caravelle*, Lockheed *Electra*.

● De Havilland Comet 4

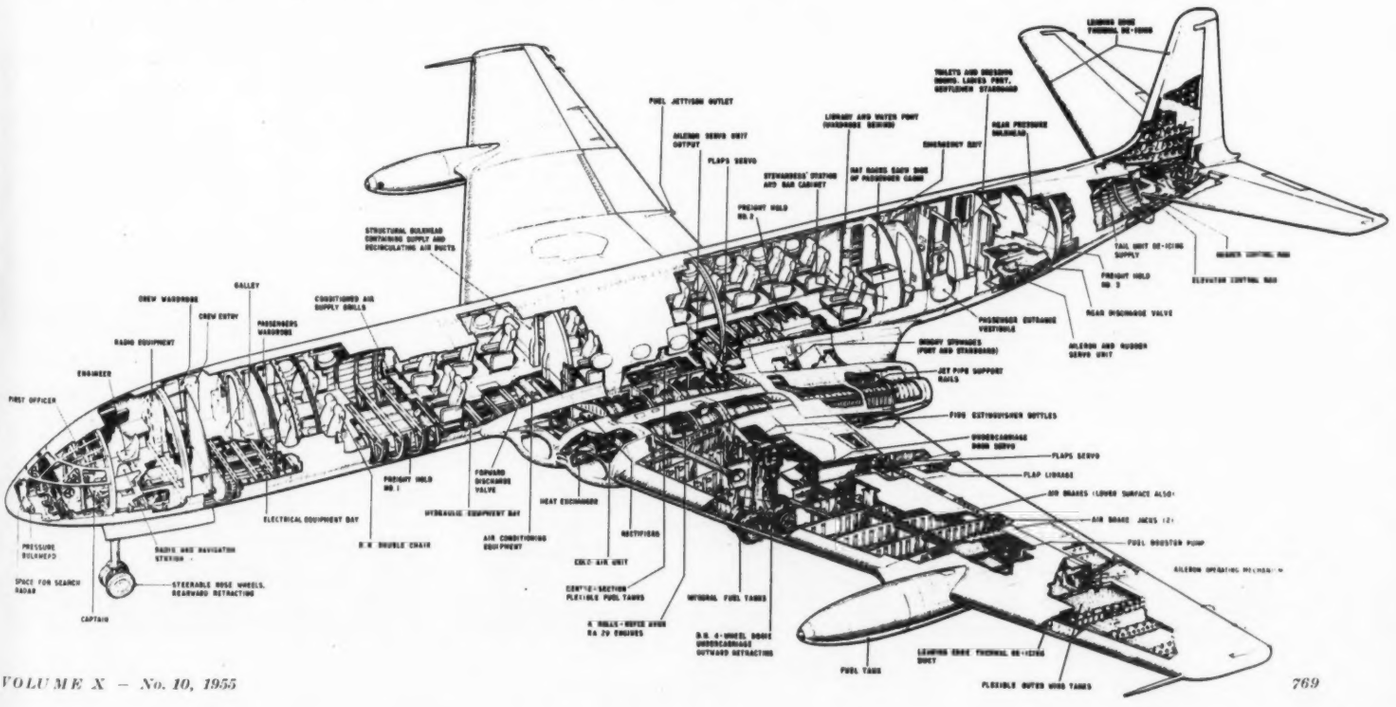
The first production models of the new, enlarged and strengthened *Comet* are now under construction at de Havilland's Hatfield plant. They bear the type designation *Mark 4* and will offer accommodation for 58 passengers in first-class operation or 71/76 in tourist-class services. First deliveries to British Overseas Airways Corporation, which has ordered twenty *Comet 4s*, are scheduled for the autumn of 1958. Power plant is the particularly low-consumption Rolls-Royce *Avon RA.29* of 10,500 lbs. static thrust, four of which will be used as in earlier *Comet* versions. Span is unchanged at 115 ft., but length has been increased to 111 ft. 6 ins.

The *prototype* of the new *Comet* (Mark 3) made its first flight in July 1954 and has already completed some 150 hours of tests. At present fitted with older R.-R. *Avon RA.16* turbojets of 9,000 lbs. static thrust each, it is to have the much more powerful, and more economical, *Avon RA.29* next year, after which it will continue its flight tests. The manufacturers hope that the *Comet 3* will be able to make some 80% of all test flights for the *Comet 4* certificate. Unlike its three predecessors, the *Comet 1* (36 passengers), *Comet 1A* (44 passengers) and *Comet 2* (44 passengers), the prototype *Comet 3* (and the later 58/76 seat production *Comet 4*) will have only oval windows and other cabin cut-outs, as these have better stress conditions than rectangular openings. Another striking modification is that the fuel nacelles which were mounted direct into the swept wing in the *Comet 3* shown at last year's S.B.A.C. Display now have inboard fillets with several fixed slots . . . presumably to prevent break-away of the flow at the wing tips in slow flight. These fillets are also retained in the *Comet 4* (see drawing).

With a load of 58 first-class passengers, the *Comet 4* can cover stages of up to 2,500 nautical miles with a payload of 16,400 lbs. For 76 tourist-class passengers the corresponding figures are 2,350 nautical miles and 19,300 lbs. In both cases stage lengths are "realistic", i.e., they allow for a 50 m.p.h. headwind and fuel reserves for 5 minutes taxying plus a diversion of 200 miles plus 30 minutes stacking at 1,000 ft. and finally 1,000 lbs. "iron reserve" for taxying at the airport of destination. Maximum take-off weight will be 152,500 lbs., maximum permissible landing weight 113,000 lbs., equipment tare weight 68,000 lbs. and maximum fuel capacity 8,750 Imp. gals. or approx. 70,000 lbs.

Although maximum take-off wing loading is 76 lbs./sq. ft., the manufacturers calculate that with the higher engine power available take-off distance will not exceed 2,380 yards at sea level at 30° C. This is 2% less than for the *Comet 3*. It is planned to fit a *thrust reversal system* to reduce landing distance.

Though the new *Comet* will not be able to cross the Atlantic non-stop, it could fly from New York to Moscow with only one intermediate landing, at Keflavik, Iceland. Above all, it should be suitable for the overland routes in Eurasia and Africa. For example, it could cover the London—Tokyo route (9,386 miles) in 22 hours with three intermediate landings (and return, with four stops, in 26 hours).



● S.N.C.A.S.E. Caravelle

At the 20th Paris Air Show in 1953 M. Georges Héreil, President and Managing Director of S.N.C.A.S.E., promised that the SE.210 *Caravelle* just ordered would be presented at the 1955 Show.

The promise was kept, and S.N.C.A.S.E.'s latest offspring could be seen manoeuvring over Le Bourget on June 18th and 19th. It had made its first flight on May 27th and completed about twenty hours of tests in the intervening period.

*

The first prototype of the SE. 210 *Caravelle* took off on its maiden flight from Toulouse-Blagnac on May 27 th, 1955.

A brief outline follows of the considerations which led the Secretariat General for Civil and Commercial Aviation to request a twin-jet medium-stage transport and S.N.C.A.S.E. to propose its *Caravelle*.

While the four-engined *Armagnac* and the twin-jet swept-wing *Grognard* were being designed and built, S.N.C.A.S.E. engineers working on advanced projects were already considering the best configuration for a jet transport. They came to the conclusion that the first requirement was to reduce drag at high altitudes to a minimum. At the same time the *Armagnac* was providing valuable experience of commercial requirements, and the *Grognard* of aerodynamic phenomena at high speeds and high altitudes.

When, in 1951, the French authorities realized the need to create fast transports to handle the traffic potential on the French network, a special committee of designers and operators appointed by the Secretariat General drew up specifications for a medium-range aircraft.

Choice of engine was left to the designer. However, the only propeller turbine available was the *Dart* which would have produced a sister aircraft to the *Viscount,* while the use of piston engines would have produced a transport little different from the twin or four-engined models already in existence. S.N.C.A.S.E. therefore prepared a project for an aircraft fitted with *three* S.N.E.C.M.A. ATAR 101 D engines mounted at the rear of the fuselage, one inside the fuselage and one each in a nacelle on either side.

Meanwhile the committee had been continuing its deliberations and finally recommended a *twin-jet model* powered by engines with a thrust of about 9,000 lbs. which would avoid the difficulty of feeding air to the centre engine. It also specified that the aircraft should be designed to be capable of "growth": i.e., it should be possible subsequently to lengthen the fuselage and fit more powerful jets. This left in practice only the Rolls-Royce *Avon*.

The final project for the *Caravelle* was submitted in June 1952 and was finally accepted by an interministerial committee in October. S.N.C.A.S.E. was awarded a contract for two prototypes on July 28th, 1953.

Advantages of the Caravelle engine arrangement

By mounting the engines in nacelles it was possible to give the airframe the following very favourable features:

— the wing remains pure in line;

— the high-lift flaps can run right through in one piece to the wing roots;

— the wing can be set very low, and the undercarriage be very short (weight saving)

— the air intakes are of high efficiency in all attitudes;

— being mounted high at the rear, the engines are beyond the region in which foreign bodies are thrown up during take-off, and the flaps, when lowered, form an additional screen;

— there are no vital parts around them to be damaged in the event of a turbine blade breaking away;

— because the engines are mounted close to the aircraft's axis and their thrust axes converge near the centre of gravity, failure of one engine produces only a very slight yawing moment;

— from the point of view of comfort, the noise zone is behind the cabin.

Other Advantages of the Caravelle

To be economical a high-speed aircraft must be capable of the same annual hours of utilization as a conventional aircraft. As, however, it can make more journeys in the same amount of time, it has a correspondingly higher transport capacity in either passengers or freight. S.N.C.A.S.E. therefore considers that the best solution is an easily adaptable mixed passenger-freight aircraft.

To ensure maximum possible utilization, the time spent in loading the aircraft, as well as actual flying time, must be reduced as far as possible, and maintenance must be as simple as possible. All these considerations were

Georges Héreil, President and Managing Director of Société Nationale de Constructions Aéronautiques du Sud-Est.

Chief Engineer Pierre Satre (second from left) and Manager André Vautier congratulating Chief Pilot Pierre Nadot and his crew after the first flight.

borne in mind in designing the *Caravelle*. For example:

— passengers enter and leave the aircraft by a door at the rear of the cabin with built-in steps;

— freight is loaded via a large door at the front;

— the floor is only 6 ft. 10 ins. above the ground, and the lower holds at shoulder height;

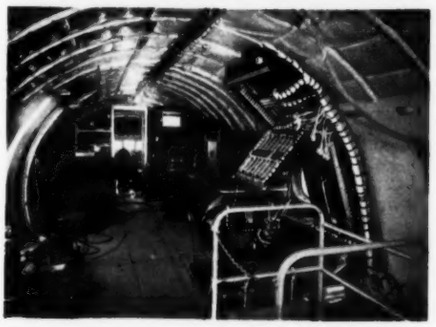
— the cylindrical shape of the cabin enables the wall separating the passenger and freight portions to be moved at will;

— the turbojets are easily accessible and can be serviced without interference with freight handling or refuelling (all fuel is carried in the wings).

*

Passengers are offered the utmost in comfort and convenience, including easy access to the cabin, racks for hand baggage, large windows on a level with each row of seats giving improved visibility downwards; low noise level because of the position of the engines and a system of glass fibre soundproofing; cabin pressure equivalent to an altitude of 8,200 ft., and air conditioning maintaining a uniform temperature and humidified atmosphere.

The *Caravelle's* cockpit.



Flight test equipment in the main cabin of the first prototype.

The *Caravelle's* four-wheel main undercarriage unit, made by Hispano Suiza.

Structural features

The aircraft's structure is simple, since wing and tailplane are aerodynamically "clean", and the fuselage is cylindrical. The only double curved parts are the wing leading and trailing edges and the engine nacelles. As the undercarriage is retracted into the wing-fuselage joint, there is no cut-out in the structure. The robust cabin floor forms a single continuous surface. The *wing* consists, in essentials, of two box spars extending over 34% of the chord and the whole span. The boxes form a flexure and torsion-resistant frame and serve as fuel tanks. They are built up from variable thickness skin in three panels spanwise, and reinforced by ribs and Z-stiffeners. The *fuselage* with pointed nose, cylindrical centre portion and rear cone, is built up of eight portions: thin sheet structure with a close grid of rings and Z-shaped stringers. The frameworks round the openings in the pressure cabin are treated as boxes; the windows are of roughly triangular shape with rounded angles to distribute the stresses. Long before the *Comet* disasters a section of the fuselage containing full samples of the metal sheet used, as well as a window and emergency exit, had been built for water tank tests; it was subjected to 40,000 pressure and decompression cycles and behaved entirely satisfactorily. The actual windows were subjected to 10,000 pressure variations with outside surfaces alternately at +50° and —50° C; rupture pressure of 142 p.s.i. on the new window fell only to 135 p.s.i. after this treatment. The *wing-fuselage joint* is of the quick-release type and adjustable.

The wing boxes run beneath the cabin floor taking up torsion from the wing and spreading it over the maximum possible length on the fuselage. A pressurized channel provides room for the controls and other circuits. The *undercarriage* consists of two main bogey units and a steerable twin-wheel nose unit. The main shock absorbers have auxiliary shock absorbers to ensure smooth touchdown.

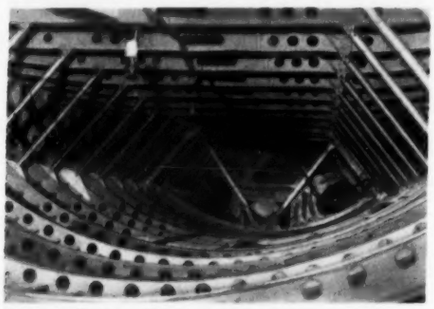
Hydraulic system: Four circuits identified by colour are each fed by a constant-delivery pump driven by the jets; regulators and batteries. Two independent jacks are fitted for each control surface to ensure reliable operation; both function simultaneously but are fed by different circuits. A third system, fed by an electric motor, can be connected to either of the main circuits as required. One of the systems operates the undercarriage, flaps, air brakes, etc. A separate emergency system is also provided, with electric motor and hand pump.

Electrical system: current is supplied by two 30-V 375-amp D.C. generators; if one generator or the jet that drives it fails, automatic (or controlled) load-shedding intervenes. There are two separate emergency batteries.

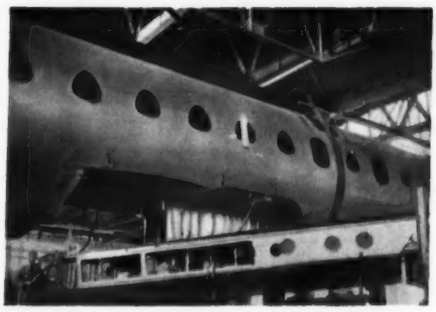
Electronic equipment is so organized that the aircraft can be operated by a crew of two. All aerials are buried. Equipment provided for

Chief Pilot Nadot leaving the aircraft through the rear door with built-in steps.

The rugged cabin floor forms a single uninterrupted surface; windows are roughly triangular.



Underneath the cabin floor.



Assembling wings and fuselage.

includes HF, VHF, radio compass, VOR receiver, ILS etc., as well as intercom.

Air conditioning maintains a temperature of 15 to 25° C in the cabin, adjustable at will, and a pressure at least equivalent to that of an altitude of 8,200 ft. Air is taken from the jet engines.

De-icing is by means of hot air bled off from the last compressor stage in the engines, with controlled delivery.

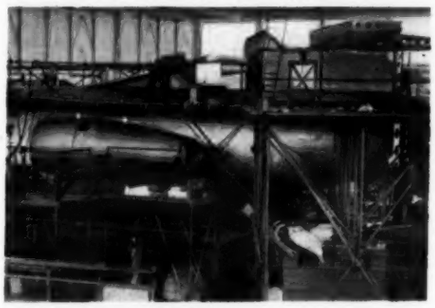
Fuel system: all kerosene is carried inside the wing box. Each turbojet is normally fed from tanks on its own side by means of buried pumps, though controlled interconnection is provided for emergency use. Pressure refuelling can be completed in less than 15 minutes. Total capacity: 3,960 Imp. gals.

Weights and design performance

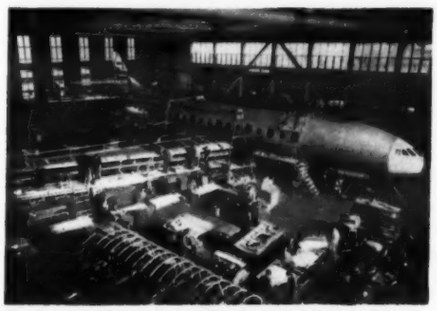
I. Weights

Airframe	28,800 lbs.
Power units	7,210 lbs.
Fixed equipment	4,550 lbs.
Movable equipment	3,610 lbs.
Electronics	725 lbs.
Crew plus equipment	850 lbs.
Operating weight empty	45,745 lbs.
Take-off weight	90,400 lbs.

Assembly rigs for the attachment of tail unit and engine nacelles at S.N.C.A.S.E.'s Toulouse plant.

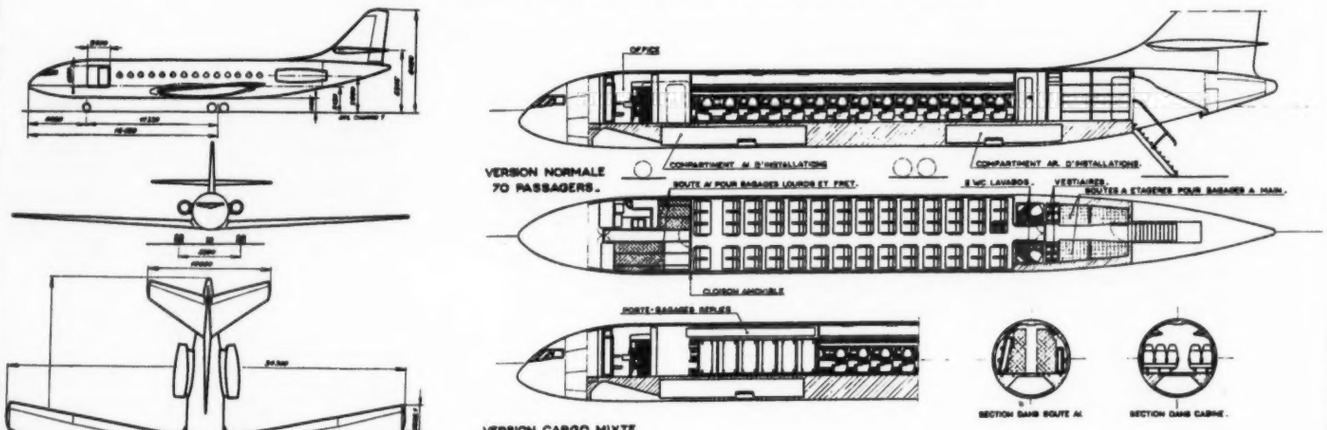


Details of the rear fuselage.



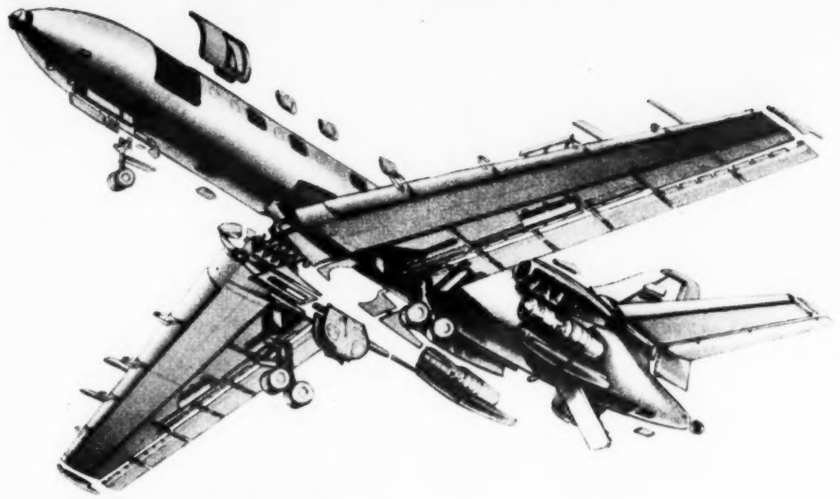
Final assembly work on the first prototype's "droop-snoot" wing slots.

Three-view drawing and seating plan of the SE. 210 "Caravelle"



Elevation and plan of normal cabin equipped for 70 passengers (first class), plus elevation and sections of the mixed passenger-freight version.

Span	112.5 ft.	Wing chord (tip)	7.3 ft.	Volume of aft hold	296.6 cu.ft.
Overall length	103.3 ft.	Wing area	1,589 sq.ft.	Volume of lower holds	434.3 cu.ft.
Height	28.5 ft.	Sweep at 25% chord	20 °	Passengers, standard version	70
Fuselage diameter	10.5 ft.	Length of cabin	44.25 ft.	Passengers, high density version	91
Tailplane span	35.4 ft.	Overall width of cabin	9.9 ft.	Technical crew	2
Undercarriage track	17.3 ft.	Width of floor	9.2 ft.	Cabin crew	2
Wheel base	37 ft.	Height of cabin	6.7 ft.		
Height of floor from ground	6.9 ft.	Volume of cabin	2,542 cu.ft.		
Wing chord (root)	20.75 ft.	Volume of forward hold	313.7 cu.ft.		



Exploded drawing showing main components.

Freight-loading door, included only in the pure freight or mixed passenger-freight version.

II. Performance (CAR rules, part 4b)

Cruising speed	490 m.p.h.
Range with 15,400 lbs. payload	1,895 miles
Range with 23,150 lbs. payload	1,320 miles
Max. range with reserves	2,610 miles
Payload for max. range	11,685 lbs.
Take-off run	1,200 yds.
Distance to 50 ft.	1,345 yds.
Take-off speed	140 m.p.h.
Landing distance from 50 ft. (max. permissible weight)	1,255 yds.
Landing run	785 yds.
Landing speed	130 m.p.h.

III. Costs

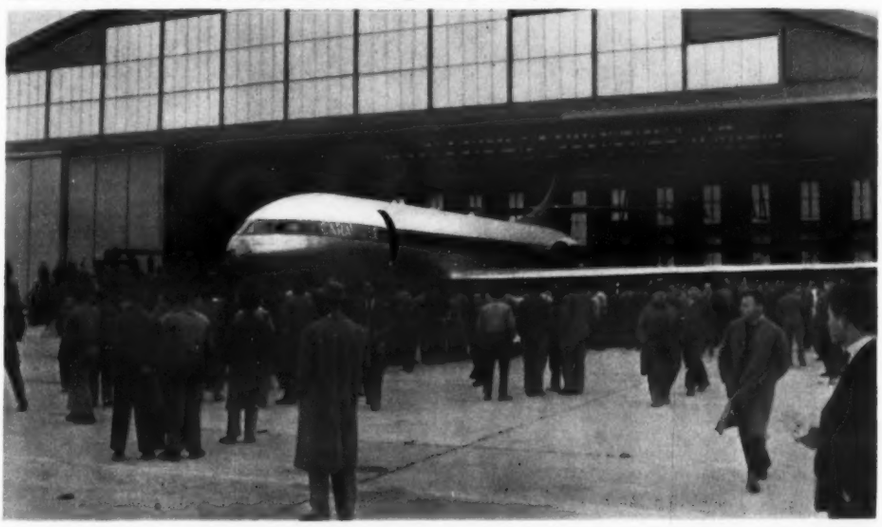
The following figures (in French francs) for costs per tonne-km have been calculated by the same method for the **Caravelle** and three other well-known types already in service:

Stage length	Convair 340 5.5 t payload	Viscount 5.8 t payload	DC-6B 9.5 t payload	Caravelle 7 t payload	Caravelle 9.5 t payload
600	53	55	—	69	52
1,000	51	46	54	56	42
1,500	54	40	48	49	37
1,800	59	39	46	47	35
2,000	62	42	44	46	34.5
2,500	—	50	43	44	39
3,000	—	—	43	45	45

Results of flight tests

The first series of flight tests culminated in the demonstration at Le Bourget on June 18th and 19th and was followed by supplementary ground tests. After a number of modifications suggested by experience of the first flights, a second series of 9 flights totalling 29 hrs. 13 mins. was made between August 2nd and 11th, the results being checked by the Government Flight Test Centre.

April 21st, 1955: the first prototype leaves the hangar ready for flight.



Up to the end of August, 1955, the aircraft had made 37 flights (32 by S.N.C.A.S.E. pilots, 5 by the Flight Test Centre) and four acceleration-stop tests at maximum load (three S.N.C.A.S.E., one Flight Test Centre). Total 53 hrs. 41 mins.

A number of flights, including take-off, were made at the maximum weight of 90,400 lbs., with one engine inoperative. Flight on one engine presents no difficulty in any attitude and demands no special skill on the part of the pilot. Cutting of one engine at 115 knots and 123 knots after take-off at full load necessitated rudder deflections of only a few degrees. Approach and landing on one engine are easy and do not even require trimming of the ailerons or rudder.

To sum up, the tests so far completed have not shown any serious defect in the aircraft's behaviour. The performance obtained at the present maximum authorized weight of 90,400 lbs. was particularly satisfactory.

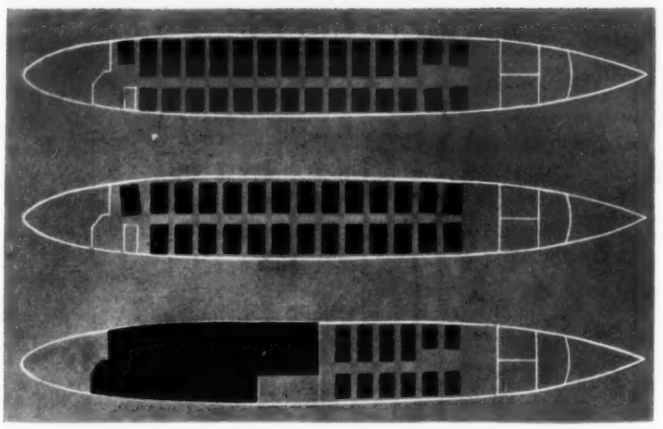
*

Confident in the success of their design, S.N.C.A.S.E. are already planning quantity production of the *Caravelle*. The production version will have Rolls-Royce *Avons* (built in France by Hispano-Suiza) with 11,000 lbs. thrust, compared with 10,000 lbs. in the prototype. This extra power will give higher speed, but the slight increase in weight will necessitate a change in weight distribution: the fuselage will be slightly lengthened in front of the wing, and the engines moved slightly forward. Safety will also be still further improved by making all doors open inwards, so that they are kept closed by the pressure inside the cabin.

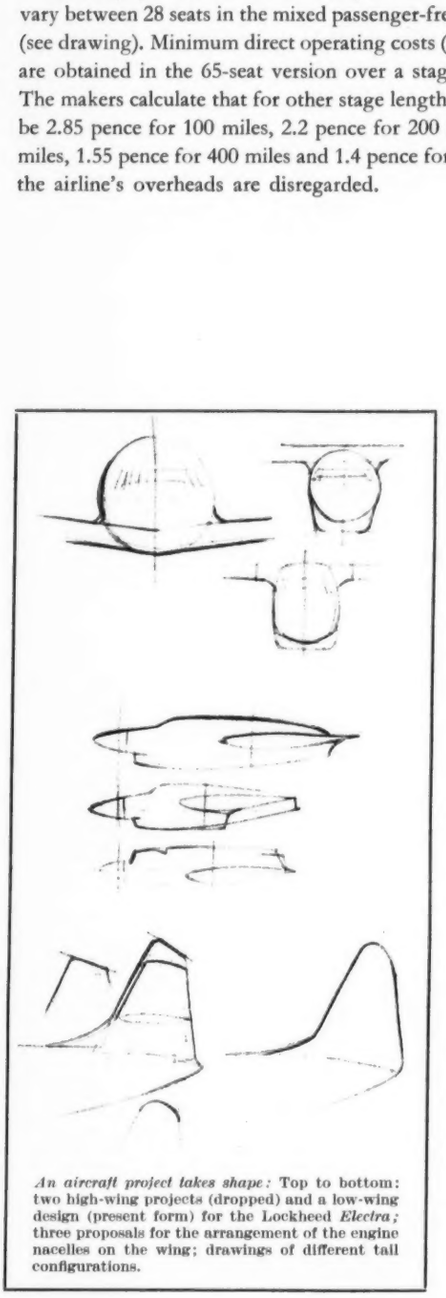
● Vickers Viscount 800

The success of the *Viscount* four-turboprop medium-stage transport has encouraged *Vickers-Armstrongs (Aircraft) Limited* to create a *short-range* version for high-payload operation. Known as the *Series 800,* it has already been ordered in substantial numbers by British European Airways, K.L.M. Royal Dutch Airlines and America's Capital Airlines. Though it has the same wing and tail unit as the *Series 700D,* its fuselage is nearly 4 ft. longer and its pressure cabin more than 9 ft. longer. It is powered by four R.-.R *Dart R.Da.6* turboprops of 1,550 s.h.p. each plus 365 lbs. residual thrust. Maximum permissible take-off weight will be 62,000 lbs., or 2,000 lbs. higher than the *Viscount 700 D.* — *Performance:* cruising speed at 20,000 ft. 276 knots; still air range with maximum payload of 14,200 lbs., 920 nautical miles; take-off distance to 50 ft. (one engine inoperative) 1,720 yards.

Cabin equipment will conform to purchasers' requirements and may vary between 28 seats in the mixed passenger-freight version and 70 seats (see drawing). Minimum direct operating costs (1.25 pence per seat-mile) are obtained in the 65-seat version over a stage distance of 800 miles. The makers calculate that for other stage lengths costs per seat-mile will be 2.85 pence for 100 miles, 2.2 pence for 200 miles, 1.8 pence for 300 miles, 1.55 pence for 400 miles and 1.4 pence for 1,060 miles. In all cases the airline's overheads are disregarded.



Three versions of the short-range Vickers *Viscount 800;* top to bottom: 70-seat high density version (seats at intervals of approx. 36 ins.) with capacity of 390 cu. ft. for baggage, mail or freight; 54-seat standard version (seat rows approx. 39 ins. apart) with 390 cu. ft. freight capacity; 28-seat version (seat rows approx. 39 ins. apart) with total freight capacity of 1,230 cu. ft.



An aircraft project takes shape: Top to bottom: two high-wing projects (dropped) and a low-wing design (present form) for the Lockheed *Electra;* three proposals for the arrangement of the engine nacelles on the wing; drawings of different tail configurations.

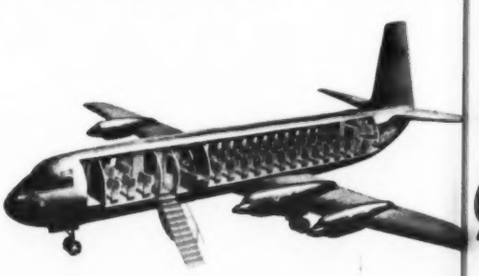
● Lockheed Electra

America's first turboprop commercial transport will be the four-engined Lockheed L-188 *Electra,* the prototype of which is now nearing completion at Lockheed's Burbank, California, plant. Although final choice of power plant for this aircraft has not yet been made—under consideration are the Allison 501 (3,750 e.h.p. civil version of the T-56), the Napier *Eland* (3,000 to 4,000 e.h.p.) and the Rolls-Royce RB.109 (3,000 to 4,000 e.h.p.) — *American Airlines* have already placed a firm order for 35 aircraft in the luxury version for 64 passengers (at an estimated price of $ 1,800,000 each). Lockheed is also offering an 80/90 seat tourist model which has aroused lively interest among several U.S. and European airlines.

For a take-off weight of 98,500 lbs. take-off distance at sea level (with Allison 501) will be less than 5,000 ft.; the corresponding maximum rate of climb is estimated as 3,000 ft./min. Lockheed gives operating range, with a 50 m.p.h. headwind and fuel reserves for two hours' flying, as 1,850 miles, or 1,600 nautical miles. With its cruising speed of 345 knots, the *Electra* will be noticeably faster than any other turboprop commercial aircraft.

From the point of view of passenger comfort, the manufacturers enumerate the following advantages: unusually wide cabin; cabin pressure corresponding to an altitude of 8,000 ft. up to the cruising height of 30,000 ft.; large rectangular cabin windows (20 × 16 ins.); individual eating or writing table for each seat; low noise level in cabin and almost complete absence of vibration; large racks for those passengers who wish to carry their baggage with them (as is common in the United States); built-in passenger steps to cut down ground waiting time. — Crew will consist of two pilots, a flight engineer and two stewardesses. Standard equipment includes reversible pitch propellers, automatic pilot and—a novelty in medium-stage operations—radar equipment for storm warning and map painting.

The *Electra* will be operated in either a 64-seat luxury version (picture: four seats per row) or a 80/90-seat tourist version (five seats per row).



Fokker Friendship

During the early days of regular air transport the Dutch firm of Fokker must have supplied more than half of all passenger aircraft used. Though, in the course of time, this situation changed radically, the attentive observer can still come across the occasional venerable Fokker F.VIIa at a European airport; and recently the Austrian Air Rescue Guard bought from Alpar, of Berne a single-engined F.XI, which has thus changed owners again after 27 years of service.

The Fokker tradition in civil transport construction is now being revived in the twin-turboprop F. 27 *Friendship* short and medium stage aircraft. A recent visit to the Fokker plant at Amsterdam-Schiphol revealed lively activity in the Experimental Shop, the birthplace of the F.27. Of the four prototypes under construction, two are for flight tests, the two others for static and dynamic tests to destruction, including fatigue tests in a specially-built water tank.

At the time of the above-mentioned visit, the "Number 1" prototype for flight testing was in final assembly and should be ready to leave the shop early in October this year. Installation of the equipment and the usual flight preparations will then take another few weeks, so that at a conservative estimate the first F.27 should be making its maiden flight around the end of the year.

A market survey completed before the *Friendship* was designed showed that a twin-turbine model with accommodation for 30 to 36 passengers and an optimum stage length of around 300 miles would best meet the needs of short and medium range services. Fokker decided on an all-metal high-wing design powered by two *Dart* propeller turbines. The high-wing lay-out offers the advantage of better aerodynamic qualities, a low-set cabin floor providing easier access to the cabin and, last but not least, undisturbed view from the cabin, a sales argument whose importance should not be underestimated.

The F.27's *fuselage* is of semi-monocoque construction and comprisse two main components: the forward portion with removable plastic nose, and the main section including the passenger cabin. The pressure fuselage, limited by two flat bulkheads, runs from behind the nose-wheel bay to aft of the baggage compartment. With the exception of a few parts, the whole fuselage is built of 24 ST dural. All double-curved skin panels are riveted to their stiffeners, while in the cylindrical portion Redux bonding is used. Skin joints are specially sealed, and all riveting is, of course, air-tight.

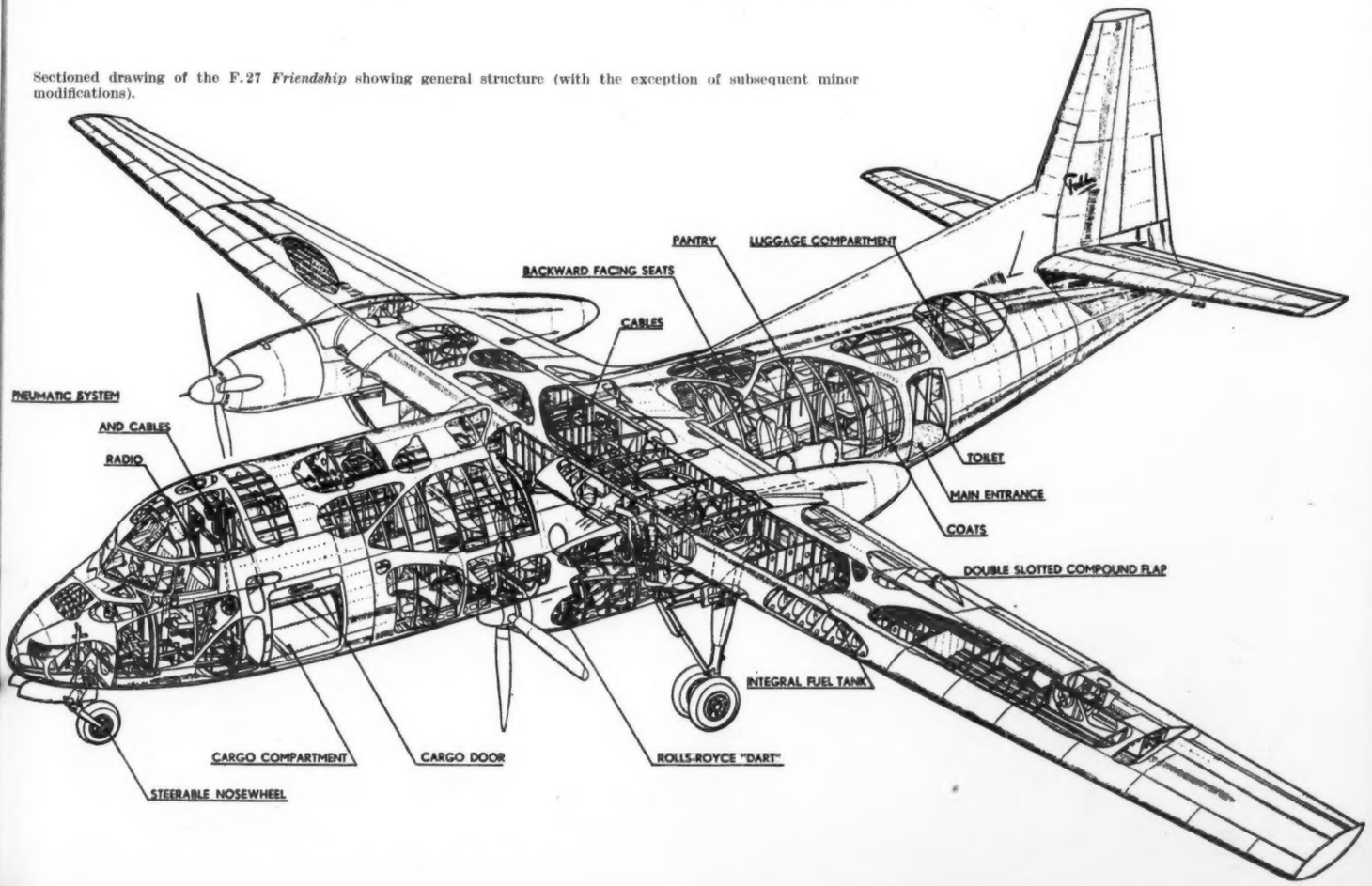
The forward fuselage section, which comprises the cockpit and a cargo compartment, is limited by the flat bulkhead mentioned above, which also carries the nose wheel attachment.—The cockpit has been designed so as to be as roomy as possible and to provide easy access to the control cables and other elements underneath the floor. All cables and controls are led upwards from the cockpit to run along the top of the fuselage.

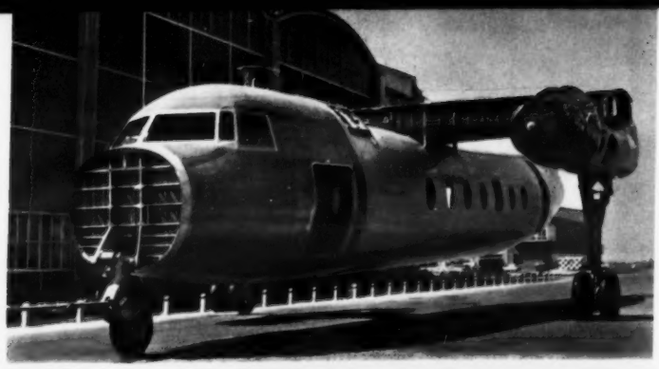
The lower section of the main fuselage is built as a separate unit. The upper section consists in essentials of frames and skin panels, with Redux-bonded stringers. Only a few frames are riveted straight on to the skin, while the majority are connected via the stringers.—The slightly flattened bottom section of the fuselage contains rigid crash members, which take the main stress in the event of a belly landing, for example, and to which the passenger seats are directly attached through the floor.

To provide greatest possible flexibility in operation, the wall dividing the forward cargo compartment from the passenger cabin is movable, so that the relative space accorded to each can be varied at will. Seats can be arranged as required, and the galley can be easily removed.

The *Friendship's* standard version seats 28 passengers, though 24 or 32 seats can be used if desired. A short stage high-density version has accommodation for 36. The volume available for cargo varies between 277 cu.ft. and 382 cu.ft., depending on the number of passengers.

Sectioned drawing of the F.27 *Friendship* showing general structure (with the exception of subsequent minor modifications).





The *high-set wing* consists of a centre section attached to the fuselage and two detachable outer sections. The centre section carries the two engine nacelles and the attachments for the main undercarriage units. A characteristic feature is the high aspect ratio (12), which requires special stiffness in structure. The main components in both centre and outer sections are a rigid torsion cell, a leading edge section and a trailing edge section. The torsion cell was given the required strength through the extensive use of 75 ST light metal alloy, without excessive weight increase. The torsion cell is built up of a forward and rear main spar, top and bottom skin panels reinforced by top-hat stiffeners, and main and form ribs. Special forged ribs are used near the outer wing attachment points. A small number of the ribs are riveted to the skin, but the majority to the stiffeners. This method gives a particularly smooth skin.—Whereas a constant-thickness skin of 75 ST duralumin with top-hat stiffeners was chosen for the wing centre section, the outer sections have a tapered skin structure. Another point worthy of note is that the top-hat stiffeners, running parallel throughout the wing, are metal-bonded to the top skin, while—for production reasons—the skin panels on the centre wing underside are riveted.—The *tailplane and fin* structure is similar in essentials to that of the wing, with the close-set stringers also Redux-bonded to the skin.—The *undercarriage*, designed by Dowty, has a hydraulic retraction system and nose-wheel steering; wheels, brakes (with Maxaret anti-skid system) and tyres are by Dunlop.

The *power plant* in the first prototype comprises two Rolls-Royce *Dart 507s* of 1,540 h.p. take-off power each, plus 350 lbs. residual thrust (at 14,500 r.p.m.). The second aircraft for flight testing will be powered by two *Dart 511* models, the version also chosen for the production *Friendship*. The *Dart 511* has a take-off power of 1,600 h.p. plus 375 lbs. residual thrust (14,500 r.p.m.); for short-period power boosts during take-off there is a water-methanol injection system. The *Dart 511* drives a Rotol four-blade propeller 12 ft. in diameter, while the *Dart 507* in the first prototype still uses a *Viscount*-type Rotol propeller (diameter 10 ft.). The whole fuel supply of 818 Imp. gals. is carried in two integral tanks in the outer wings.

*

A major role in the development of the *Friendship* was played by the tests carried out at the National Aeronautical Laboratory in Amsterdam before work started on the prototypes. Wind tunnel tests with models of the F. 27 provided valuable information on the most favourable fuselage-wing connection, suspension of the engine nacelles, shape of the fuselage nose and design and position of the landing flaps. For example, five different engine nacelle suspensions were tested. Four different nose configurations were tried out in order to arrive at optimum visibility conditions for the crew; the version finally chosen has a drag that is only 3% higher than the ideal streamlined shape. Finally, a wing model of 2 ft. chord was used to test three main types of landing flaps: a NACA TR 824 double-slotted flap, a Fokker-designed compound flap and a Fowler flap. Each type was tested with a variety of different slot shapes and positions. The Fokker flap was found to be most suitable for use in the *Friendship*.

Four prototypes of the *Friendship* are being built, two for flight testing and two for static and dynamic strength tests. Pictures show the first prototype (for flight tests) at various stages of completion. Note the two main components which make up the fuselage: the forward section with cockpit and removable plastic nose, and the main fuselage with passenger cabin.—Power plant in the first prototype is two Rolls-Royce *Dart 507* propeller turbines of 1,540 s.h.p. plus 350 lbs. residual thrust each and *Viscount* type four-blade Rotol propellers. The second flight test prototype and the production models will have *Dart 511* engines of 1,600 s.h.p. plus 375 lbs. Power can be increased for take-off by water methanol injection.

Engine data (Rolls-Royce **Dart 511**)

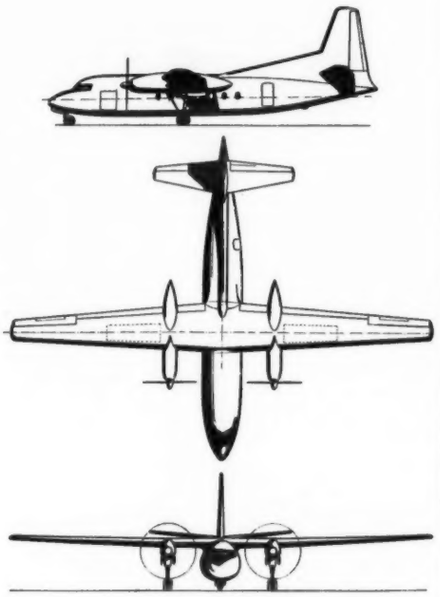
Take-off power (static) at sea level.....1,600 s.h.p. +375 lbs. at 14,500 r.p.m.
Max. climb power (static) at sea level.....1,300 s.h.p. +305 lbs. at 13,800 r.p.m.
Max. cont. power (static) at sea level.....1,300 s.h.p. +305 lbs. at 13,800 r.p.m.
Full take-off power can be retained by water-methanol injection up to temperatures of I.S.A. +30 °C and altitudes of up to 10,000 ft.

General dimensions and weights

Span	95 ft.	Normal take-off weight	32,630 lbs.
Length	73 ft.	Max. take-off weight	34,200 lbs.
Wing area	754 sq.ft.	Max. disposable load	12,515–12,875 lbs.
Aspect ratio	12	Max. payload	9,175– 9,535 lbs.

Performance (for normal take-off weight of 32,630 lbs.)

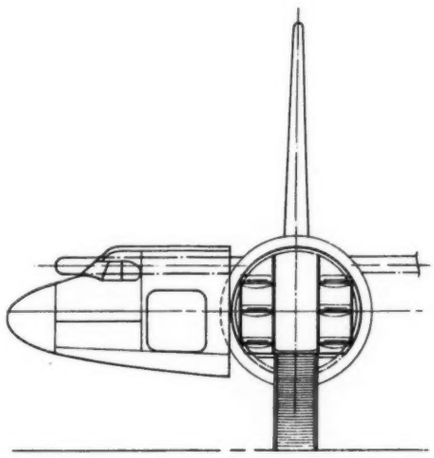
Max. cruising speed at 20,000 ft. and 13,800 r.p.m.	280 m.p.h.	Normal stage length with reserves (S.B.A.C. method)	300 miles
Economical cruising speed at 20,000 ft. and 13,600 r.p.m.	275 m.p.h.	Max. stage length with reserves (S.B.A.C. method)	1,000 miles
Rate of climb at sea level, I.S.A.	1,500 ft./min	Block speed, normal stage	203 m.p.h.
Rate of climb, sea level, I.S.A. +15 °C	1,220 ft./min	Take-off distance, both engines (I.C.A.O.)	2,400 ft.
Service ceiling (100 ft./min climb)	35,000 ft.	I.C.A.O. take-off runway	3,800 ft.
Operating altitude on one engine (climb 0.02 V^2_{so})	12,500 ft.	I.C.A.O. landing runway	3,800 ft.



● Aviation Traders Accountant

A brief two years ago the London firm of *Aviation Traders (Engineering) Ltd.* for the first time joined the ranks of the British aircraft manufacturers working on Douglas DC-3 replacements, by producing the design for a twin-turboprop passenger and freight transport named the *Accountant*. At first glance, the design appears to be entirely conventional: all-metal low-wing monoplane with single tail unit and retractable nose-wheel undercarriage; however, the wing unit is immediately seen ot have a relatively high aspect ratio (10.77), and the rudder unit is strikingly large in area. On closer inspection it is recognizable that the makers have chosen a novel type of structure for the fuselage with its pressure cabin. Known as Heal or Petal construction, the method is based on the following principles.

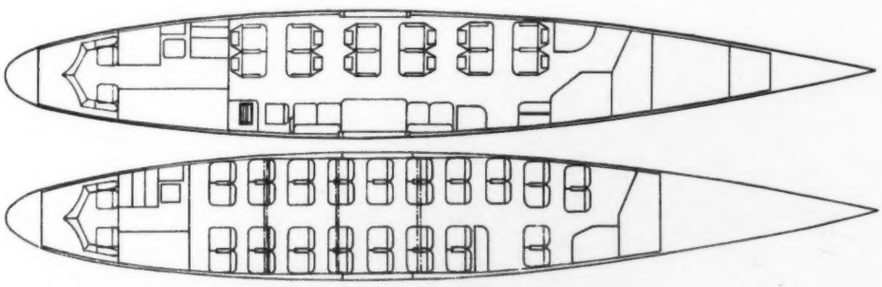
The centre and rear sections of the fuselage are of symmetrical streamlined shape, combining both aerodynamic and structural advantages. Instead of using stretcher presses to shape the skin sheets (an expensive process because of their double curvature), the skins are cut to their final shape in the flat, rather like the panels of a parachute. The skins run from the back of the pilot's cockpit to the end of the fuselage. Cockpit (and nose of the fuselage) are made separately and hinged to the remainder of the fuselage, so that they can be swung aside if required (in the freight or ambulance versions).



The Accountant's nose (including cockpit) is assembled separately and attached to the fuselage in such a way that it can be swung open sideways if required (in the freight or ambulance version, which can carry 17 patients on stretchers, four more on seats and the necessary attendants).

Because of the symmetrical shape of the fuselage, all skin sections are identical. Hence a number of panels can be cut out and drilled at a time by means of simple master patterns. The skins are then stiffened locally by formers and stringers, attached to a frame at one end and stretched manually into the final form. Finally, they are riveted together, producing a very strong, light and cheap structure. Apertures for windows, doors and wing attachments are cut out of the fuselage afterwards.

Wing and tail unit are of more or less conventional design. The thermally de-iced wing is built up on two spars and consists of two



From the operational point of view the *Accountant* is designed for great flexibility. It can be used as six-to-twelve-seat executive or luxury touring aircraft (cabin plan top), or as a feeder transport for 34 to 36 passengers (cabin plan bottom).

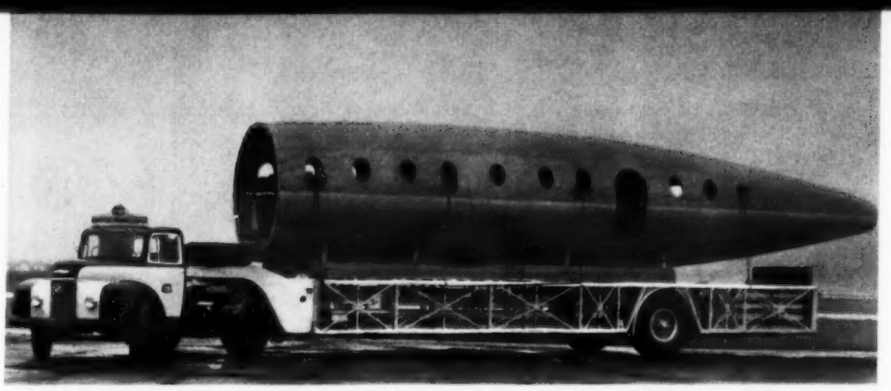
halves joined together on a level with the fuselage centre line. Double slotted flaps are fitted to the outer wings adjoining the ailerons; the inner wings also have slotted slaps. Not only the wing unit but also the tail unit and all control surfaces and flaps are of all-metal construction.

The Dowty *undercarriage* uses twin wheels throughout. The nose wheel is steerable, and the brakes on the main wheels are equipped with Dunlop "Maxaret" anti-skid devices. Undercarriage track 21 ft. 8 ins.

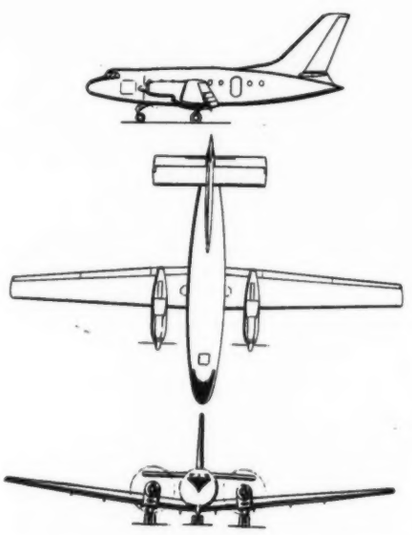
Power plant comprises two Rolls-Royce *Dart RDa.6* propeller turbines and 10-ft. four-blade propellers. Take-off power, normally 1,600 s.h.p. for each engine, can be increased for short periods by injecting water-methanol. Normal fuel capacity, carried in wing tanks outside the engine nacelles, is 9,040 lbs. maximum.

*

From the operating point of view the *Accountant*, a first prototype of which will be ready for flight testing by the end of 1955 (first deliveries could begin in 1957), features outstanding flexibility in both civil and military use. It can be used as a 6-to-12-seat executive or luxury touring aircraft, with a crew of two or three; the standard transport version accommodates 28 passengers, and a tourist-class version 36; and models for mixed passenger-freight transport, pure freight transport and ambulance and survey duties are planned.



The fuselage centre and rear portions form a symmetrical streamlined body. The skin panels are left flat and cut to shape to fit the varying bulkhead diameters. All fuselage panels are identical. The required stiffening is obtained by stringers riveted in position. The panels are then attached to a frame at one end and stretched manually into the final form. Finally, they are riveted together.



Dimensions and weights

Span	82 ft. 6 ins.
Length	60 ft. 6 ins.
Wing area	632 sq.ft.
Aspect ratio	10.77
Gross weight	28,000 lbs.
Payload for 1,570 nautical miles	2,788 lbs.
Payload for 200 nautical miles	9,400 lbs.

Performance

Mean cruising speed at 25,000 ft.	246 knots
Mean cruising speed at 30,000 ft.	243 knots
Rate of climb at sea level and max. take-off weight	1,532 ft./min.
Max. range (auxiliary fuel) at gross weight of 28,000 lbs.; endurance	2,400 n.m. 10 hrs.
Max. range (auxiliary fuel) at gross weight of 29,000 lbs.; endurance	2,700 n.m. 11.25 hrs.
Normal cruising altitude	25,000 ft.
Max. cruising altitude	30,000 ft.

Take-off

Take-off distance (I.C.A.O.)	2,690 ft.
Take-off field length	3,050 ft.

Landing

Landing distance (I.C.A.O.)	2,200 ft.
Landing field length	3,140 ft.

Operating costs (annual utilization 2,000 hours)

Stage	Altitude	Costs
250 n.m.	5,000 ft.	16.7 pence/long ton nautical mile
350 n.m.	15,000 ft.	14.5 pence/long ton nautical mile
500 n.m.	25,000 ft.	13.5 pence/long ton nautical mile

● Hurel-Dubois HD.32/HD.321

France's contribution to the contest for a DC-3 replacement on short stages is formed by the two unusual narrow-wing designs of *Société des Avions Hurel-Dubois*, the HD.32 (*picture*, with two Pratt & Whitney R-1830s) and HD.321 (two Wright 982-C.9s), whose high aspect ratio (20.5) gives them exceptionally short take-off and landing distances. They can carry up to 44 passengers—or a smaller number of passengers plus cargo—on short to medium stages and are also capable of taking off and landing on grass airfields. As this interesting configuration has already been described in detail in *Interavia* (No. 12, 1952, pp. 695–699), only the principal data need be given here (see table).

Type	HD. 32	HD. 321
Engine	R-1830-92	982-C. 9-HE1
Take-off power	2 × 1,200 h.p.	2 × 1,525 h.p.
Span	148 ft. 7¼ ins.	148 ft. 7½ ins.
Length	76 ft. 4 ins.	76 ft. 4 ins.
Wing area	1,076.4 sq.ft.	1,076.4 sq.ft.
Aspect ratio	20.5	20.5
Max. take-off weight	39,680 lbs.	44,100 lbs.
Max. payload for 620-mile stage	12,170 lbs.	16,310 lbs.
Economic cruising speed	168 m.p.h.	171 m.p.h.
Max. still air range	1,650 miles	1,490 miles

● Handley Page Herald

Chief preoccupation underlying the *Herald* design—as in the case of the *Accountant*—was to create a passenger and freight transport capable of a wide range of applications at the lowest possible operating costs. Structure was determined by the requirement for economical production. The aircraft also shows a number of interesting features, some of which reflect recent experience of fatigue rupture.

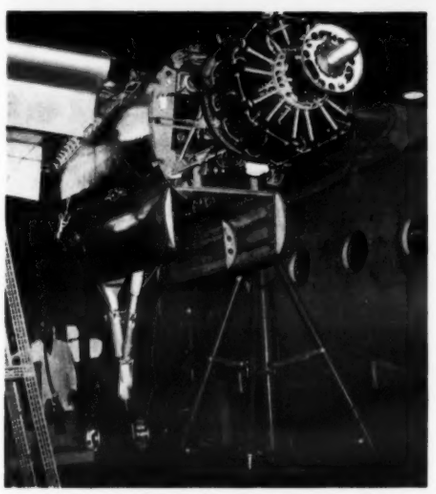
The *fuselage* is of stressed skin construction, with skin panels spot-welded to stringers, which are in turn pop-riveted to the frames. The centre portion has two box-section main frames which serve as wing attachments and are sufficiently strong to withstand belly-landing loads.—There are three main bulkheads, one at the front of the cockpit, a second between the cockpit and the cabin, and the third at the rear of the cabin. The first and third are pressure bulkheads.

Access to the cabin is from the port side by a crew-entry door just behind the cockpit and a large double doorway at the rear of the fuselage for passengers and freight. There are also two escape hatches on the starboard side of the fuselage. The quickly detachable double seats can be fitted to face either forwards or backwards.

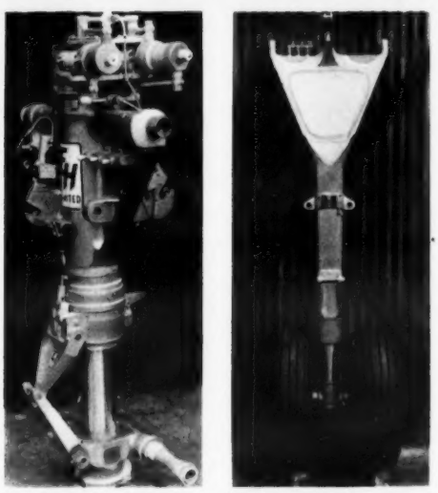
The *Herald* can be used as pure cargo aircraft, as passenger transport or as mixed passenger-freight transport. In the pure freight version load capacity is 1,575 cu.ft., leaving gangways clear. The passenger version with 44 seats has a cabin floor area of 220 sq.ft.; in this arrangement the bulkheads divide the fuselage so as to give 90.5 cu.ft. of space forward of the cabin and 171 cu.ft. aft, for freight and baggage. The combined passenger-freight version with a seating capacity of 36 gives a forward space of 183.5 cu.ft. and a cabin floor space of 204 sq.ft. The rear freight compartment is standard for all passenger lay-outs. Finally there is a combined version for 24 passengers, with a cabin floor space of 166.8 sq.ft. and forward freight capacity of 469.5 cu.ft.

The *wing unit* comprises a centre section, two outer wings and two wing tips. Ailerons extend over roughly 40% of the span, and Fowler flaps are fitted between ailerons and fuselage.

In the centre section the skin is a metal sandwich made of a corrugated filler spot-welded to an inner and outer skin. These sandwich skin panels carry bending and end-loads, an arrangement which enables highly-stressed booms, susceptible to fatigue, to be avoided. Shear

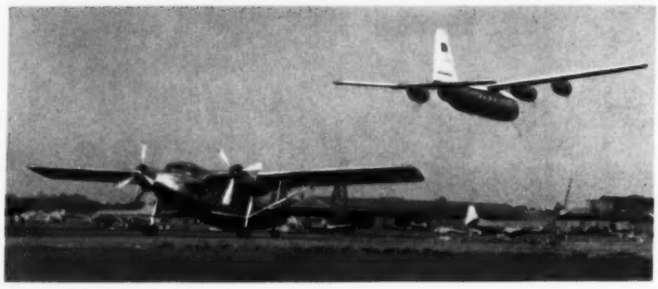


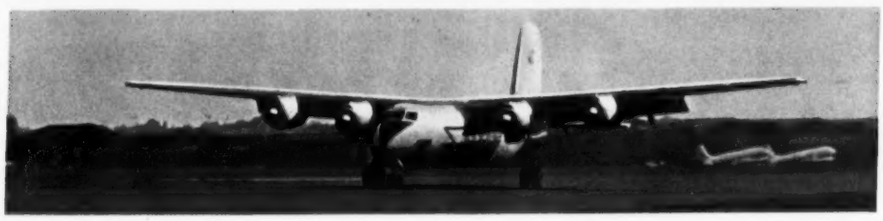
Four 870 h. p. Alvis *Leonides Major* two-row radials are used in the *Herald*. They are installed on ring mountings attached at four points to the firewall of the monocoque engine nacelles.



The *Herald* is fitted with an Electro-Hydraulics retractable undercarriage, with twin wheels throughout. Left, the nose wheel unit (hydraulically steerable); right, one of the main units.

Final assembly of the Handley Page *Herald* prototype.





The *Herald* made an excellent impression at this year's S.B.A.C. Display at Farnborough. – Top left: take-off for a demonstration flight at Farnborough. – Top right: while the *Herald* was showing its paces, the Scottish Aviation *Twin Pioneer* for 14 to 16 passengers was preparing for take-off.

Below: The *Herald* landing.

loads are taken by three lightly-loaded web members. The centre web is a corrugated metal sandwich, and the other webs are built up of a stiffened light-alloy plate.

The outer wings are attached to the centre section by a series of bolts which carry the load from the outer wings into the sandwich skin panels. The outer wings are of stressed-skin construction and have two webs (extensions of the forward and rear webs in the centre section) and a number of pressed diaphragm ribs.

A special feature of the *Herald* wing is that the number of ribs required has been reduced to a minimum. The only ribs in the centre section, for example, are at the load-carrying attachment points to the fuselage, nacelle, undercarriage and wing.

Use of fluted skin has made construction of the tail unit extremely simple, since need for internal structure is reduced to a minimum. The two-piece tailplane has three spars and pressed light alloy sheet ribs; the elevators have two spars. The fin is of similar construction to the tailplane, and the rudder has three spars.

Low-pressure tyres on the hydraulically operated retractable *nose-wheel undercarriage* with twin wheels enable take-off and landing to be made on grass runways. Main and nose units have single oleo-pneumatic shock absorbers; the nose wheel is steerable and can be turned through an angle of $\pm$ 55°. The wheel unit has a hydraulic self-centring mechanism and can be released to caster through 360° by a spring-loaded catch. Shock-absorber legs are by Electro- Hydraulics, wheels and tyres by Goodyear.

Power plant in the present version comprises four Alvis *Leonides Major* two-row radial engines of 870 h.p. each take-off power and three-blade constant-speed variable pitch propellers. Normal fuel supply, carried in four tanks in the wing centre section, is 700 Imp. gals.; auxiliary tanks with a total capacity of 300 gals. can be fitted in the outer wing roots if required.

Dimensions and weights

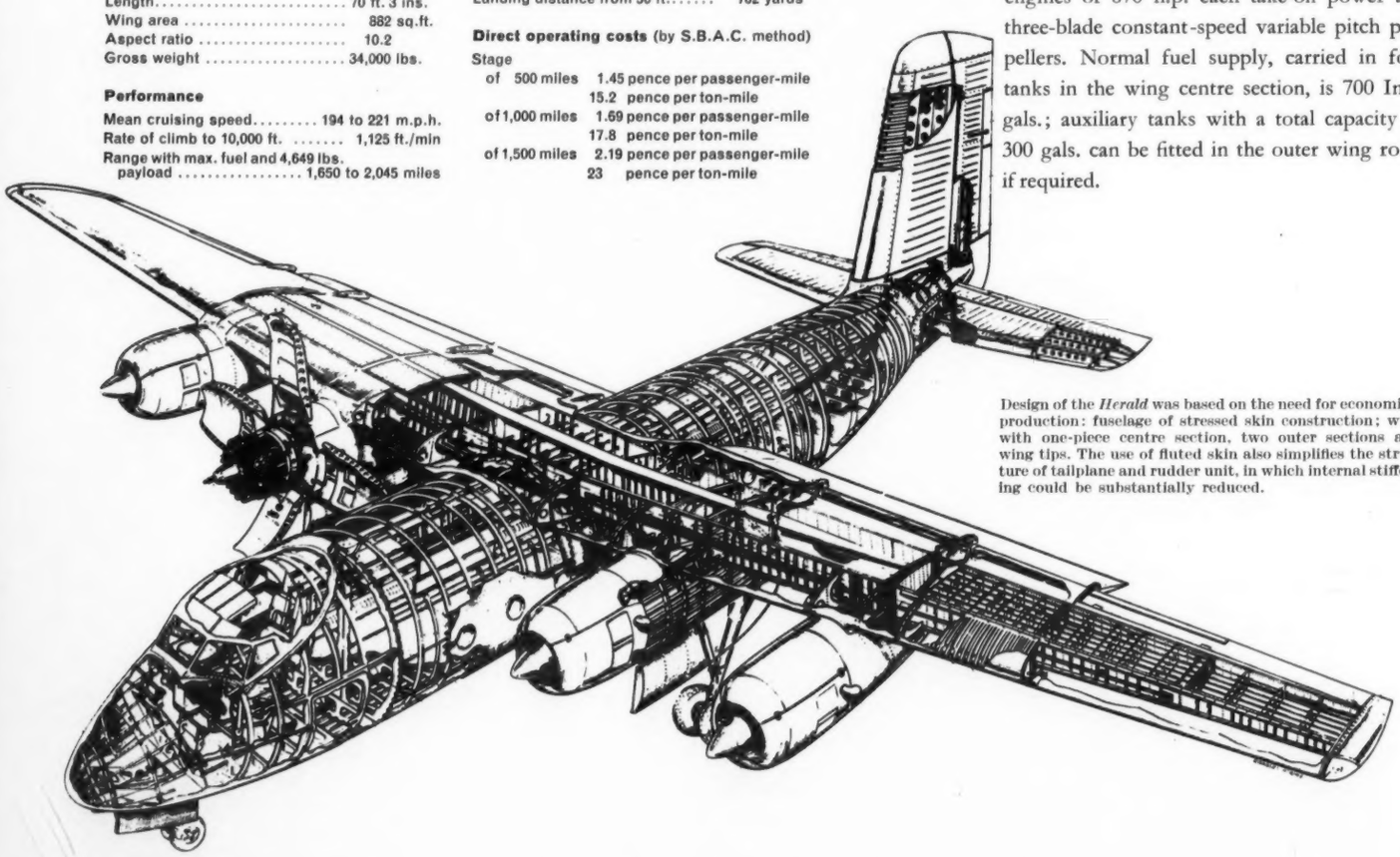
Span	95 ft.
Length	70 ft. 3 ins.
Wing area	882 sq.ft.
Aspect ratio	10.2
Gross weight	34,000 lbs.

Performance

Mean cruising speed	194 to 221 m.p.h.
Rate of climb to 10,000 ft.	1,125 ft./min
Range with max. fuel and 4,649 lbs. payload	1,650 to 2,045 miles
Take-off distance to 50 ft.	576 yards (sea level)
Take-off speed	99.5 m.p.h.
Landing distance from 50 ft.	762 yards

Direct operating costs (by S.B.A.C. method)

Stage		
of 500 miles	1.45 pence per passenger-mile	
	15.2 pence per ton-mile	
of 1,000 miles	1.69 pence per passenger-mile	
	17.8 pence per ton-mile	
of 1,500 miles	2.19 pence per passenger-mile	
	23 pence per ton-mile	



Design of the *Herald* was based on the need for economical production: fuselage of stressed skin construction; wing with one-piece centre section, two outer sections and wing tips. The use of fluted skin also simplifies the structure of tailplane and rudder unit, in which internal stiffening could be substantially reduced.

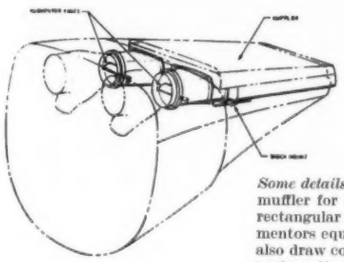
● Convair-Liner 440

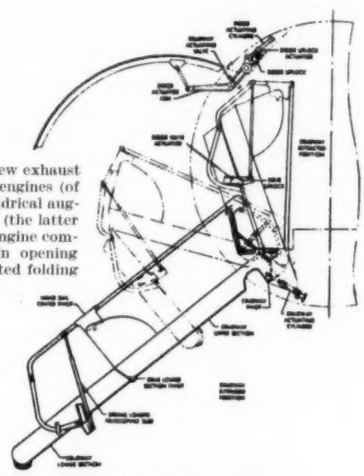
In July 1955 the *Convair Division of General Dynamics Corporation* worked out the provisional type specification for a modernized version —the Model 440—of its well-tried *Convair Liner,* which is now being circulated among all interested airlines. Using the same external dimensions as its predecessor, the Convair 340, and the same fuel capacity (1,730 U.S. gallons), the Convair 440 will be ready for delivery from the spring of 1956 in a standard medium-stage 44-seat version designed primarily for U.S. domestic services (see seating plan below) and in at least two short-stage versions for 48 and 52 passengers. Firm orders for short-range versions have already been placed by Scandinavian Airlines System (11 aircraft for 52 passengers), Sabena (12 aircraft for 48 passengers), Swissair (8 aircraft for 44 passengers), the Brazilian Real-Aerovias (2 aircraft) and the Finnish Aero 0/Y (one aircraft).

Power plant comprises Pratt & Whitney R-2800 *Double Wasp* 18-cylinder two-row radials with Hamilton Standard three-blade Hydromatic propellers. The choice of engine version (CB-16 of 2,400 h.p. "wet" take-off power, or CB-17 of 2,500 h.p.) is left to the customer. It is also rumoured that the manufacturers are investigating, at the suggestion of one airline, the installation of auxiliary turbojets in the 1,000 lbs. thrust class (at the wing tips), to be used only during climb so as to increase block speeds on short routes.

All Convair 440s will have the new soundproofing already tried out in the 340 and rectangular exhaust nozzles, and will probably retain the 340's built-in passenger steps (see picture). They will also have pressure cabin, air conditioning, oxygen equipment for the crew and five passengers, Sperry A-12 autopilot, HF and VHF radio equipment and intercommunication system, and finally latest radio navigation aids (two VOR and Glide Path receivers, a marker beacon receiver, two radio compasses).

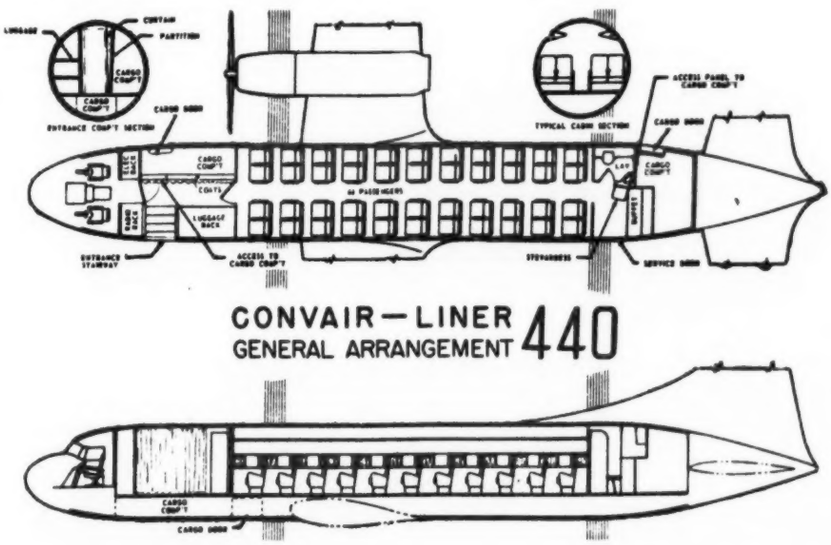
Like this 44-seat Convair Liner 340 of United Air Lines, the new Model 440 (for 44, 48 or 52 passengers) can be provided with built—in loading steps and airborne radar. The latter is fitted behind the plastic nose canopy and is used for storm warning (indicating cumulo-nimbus clouds) in flight and for map painting in bad visibility.





Some details of the Convair 440: New exhaust muffler for the Pratt & Whitney engines (of rectangular section) with two cylindrical augmentors equipped for afterburning (the latter also draw cooling air through the engine compartment); door to pressure cabin opening upwards, with hydraulically operated folding stairway.

Seating plan for the 44-seat standard version for U.S. domestic services.



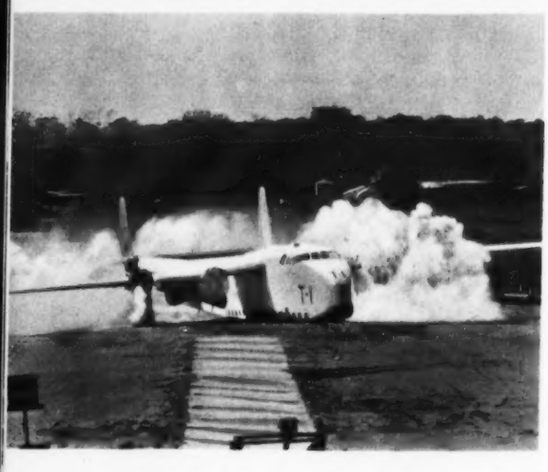
Dimensions, weight, performance

(Convair 440 with R-2800 CB-16 or CB-17)

Span	105 ft. 4 ins.
Length	79 ft. 2. ins.
Height	28 ft. 2 ins.
Wing area	920 sq.ft.
Mean aerodynamic wing chord	9 ft. 6.3 ins.
Aspect ratio	12
Undercarriage track	25 ft.
Max. take-off weight (with CB-16)	48,000 lbs.
Max. take-off weight (with CB-17)	49,100 lbs.
Max. landing weight	47,650 lbs.
Weight empty (44-seat version)	31,000 lbs.
Cruising speed at 20,000 ft. with cowl flaps closed (1,200 b.h.p. engine)	289 m.p.h.
Range, no wind, at 20,000 ft. with 1,050 b.h.p. engine, take-off weight 48,000 lbs., fuel 1,113 gals. (1,500 lbs. reserve)	1,150 miles
Range, no wind, at 20,000 ft. with 1,050 b.h.p. engine, take-off weight 49,100 lbs., fuel 1,313 gals. (1,500 lbs. reserve)	1,410 miles
CAR take-off runway length at sea level with max. take-off weight (CB-16)	4,930 ft.
CAR take-off runway length at sea level with max. take-off weight (CB-17)	5,000 ft.
CAR landing runway length at sea level, landing weight 46,800 lbs.	4,010 ft.

N.A.C.A. Investigates

- **Prevention of crash fires**
- **Safety of occupants in crash landings**



To investigate the various phases of a crash fire in jet engines, N.A.C.A. fitted a Fairchild C-82 transport with two turbojets under the wings and allowed the aircraft to crash into a barrier at 90 m.p.h. Results: fracture of the wing fuel tank, whose contents were spilled (top); engines continue to run, sucking in fine fuel spray through the air intakes; explosive ignition of fuel on hot parts inside the engine. Finally, a flame issuing from the port engine sets the whole fuel cloud on fire (centre and bottom).

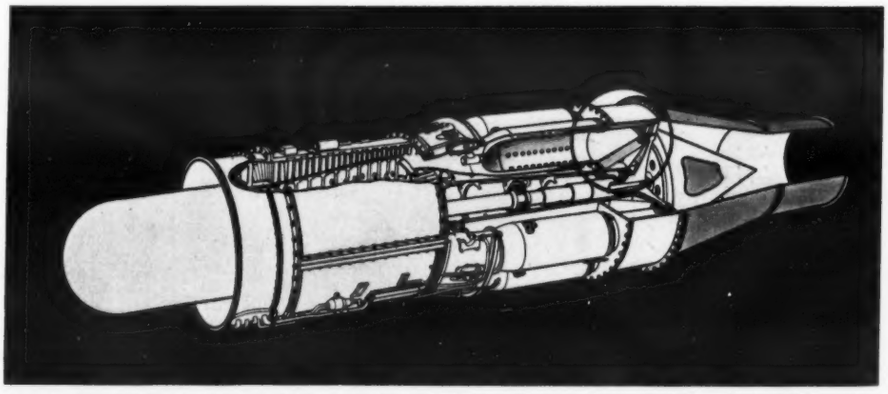
I. Preventing crash fires

Some time ago the National Advisory Committee for Aeronautics investigated the causes of fire in crash-landed piston-engine aircraft. In the course of this extensive research programme valuable information was obtained, which was then incorporated in certain new aircraft designs. Some of the questions answered were how combustibles (fuel, oil, hydraulic fluid) spill in a crash, when and where ignition occurs, how combustible fluids reach the ignition centre and so on.—When N.A.C.A., recently undertook a similar investigation of jet aircraft, it was found that though many of the causes of fire experienced in piston-engine aircraft are also present in jet aircraft, there are basic differences. Tests with jet fighters withdrawn from service showed that the danger of crash fires is substantially greater in turbojet models.

As the jet engine has no propeller (which immediately brings the engine to rest on striking the ground), it continues to run after the crash, sucking great quantities of air into the intake. At the same time fuel and lubricants spilled on impact can also be drawn in and ignite explosively on the hot parts inside the engine. The flames shooting out of the intake and jet pipe can ignite fuel spilled out of tanks and set the whole aircraft on fire. In order to study this process in practice N.A.C.A. mounted two turbojets under the wings of a Fairchild C-82 transport and ran the aircraft at approximately 90 m.p.h. into a crash barrier (see left-hand row of pictures). Although fuel supply was automatically cut off at the moment of impact, the fuel spilled from the tanks ignited inside the engines and soon enveloped the whole aircraft in flames.

Test bench studies showed that fuel ignites inside the engine only on those hot surfaces where local air velocity is low. There is no ignition on parts where air velocity is high. As there are only few "hot" zones in a jet engine where air flow is slow, it was found feasible to cool these surfaces by spraying on cold water. An automatic water spray system was then developed for the General Electric J-47. The drawing below shows the position of the parts requiring cooling. The cooling water was carried under high gas pressure in special tanks, which at the moment of impact sprayed their contents via a distributor system onto the critical engine parts.—This system was used in six different tests (see right-hand row of pictures). In no case did spilled fuel catch fire.

The method is to be tested in other jet engines, in particular those with a high compression ratio, in a further series of tests.



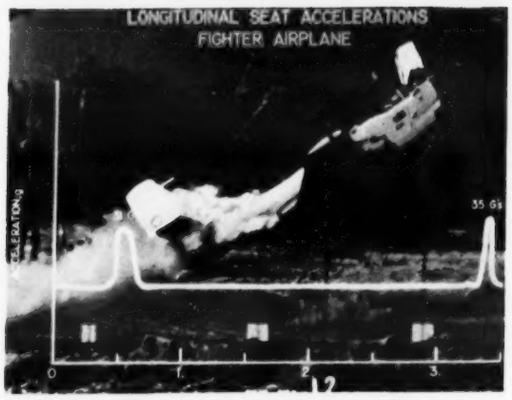
A water spray system for the prevention of fire in the J-47 jet engine: at the moment of crash the cooling water (9 gallons) is sprayed under gas pressure through a distributor system on to the combustion chambers, the outside surface of the transition liners, both faces of the turbine wheel, the tail cone and the jet pipe. Danger spots are shaded or circled.

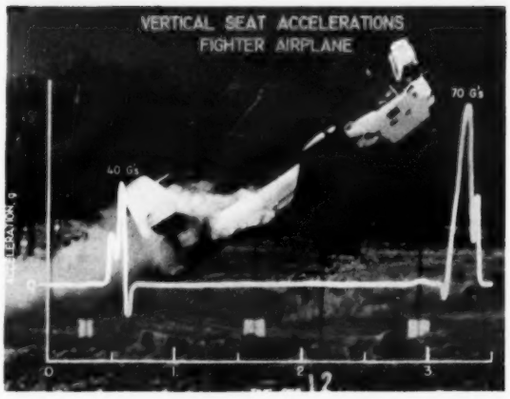
Experimental crash by a pilotless Republic F-84 *Thunderjet* fighter. The F-84 runs at about 110 m.p.h. into a sand barrier; fuel spilled out when the airframe bursts ignites on the hot engine and envelopes the whole aircraft in flames.

Repetition of the same experiment under similar conditions but using a water spray system to cool the engine on crashing: the airframe breaks open, but the spilled fuel does not ignite.

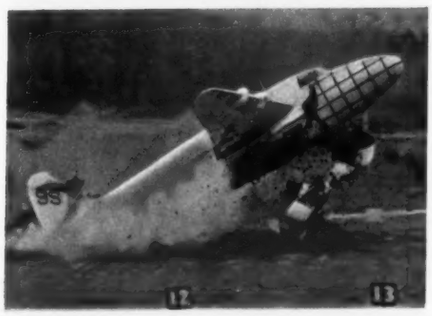
Crash landing by an unmanned McDonnell FH-1 *Phantom* jet fighter: immediately the aircraft crashes into the mound of earth, the water spray system goes into operation, as may be seen from the vapour issuing from the jet pipes. Although the aircraft broke in the middle of the fuselage after the second crash, no fire occurred.

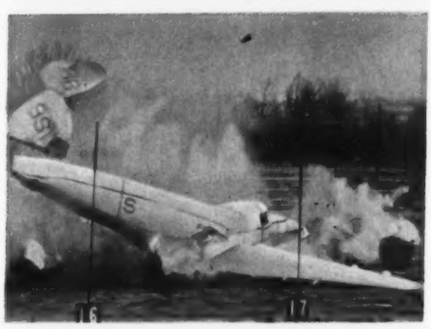
In order to test reliable, fast methods of rescuing occupants of aircraft forced down on the water, the U.S. Navy in collaboration with C.A.A. carried out a series of experiments with the fuselage of a Martin 404. The tests were made at Norfolk, Virginia, Naval base, which also developed the flotation system for the fuselage. The latter consists of four flotation tanks fitted at each end of the stub wings and on either side of the fuselage. Flotation pressure can be varied to give the fuselage any desired angle to the surface of the water.





The following deceleration and acceleration values were measured in a crash test by a McDonnell FH-1 *Phantom* jet fighter: maximum deceleration in the direction of movement approx. 35 g (left); maximum acceleration in the vertical approx. 70 g (right). Vertical acceleration and horizontal deceleration reach their maximum values at the same moment, roughly 3.3 seconds after the beginning of measurements.





To test a new-type passenger seat with elastic pedestal, N.A.C.A. made an experimental crash on a remote-controlled Lockheed *Lodestar* at Ravenna, Ohio. Inside the cabin were six dummies equipped with instruments to record inertia forces. The dummies were also photographed during the crash by an automatic camera (rectangular box under the cabin roof in the top picture).

II. Safeguarding passengers and crew in crash landings

Measures to prevent crash fires are only worthwhile if the occupants of a crash-landed aircraft survive the high accelerations and are not injured if the cabin breaks up. The magnitude of the in part decelerating and in part accelerating forces in certain crash conditions is shown in the two illustrations above.

In seeking ways of increasing survival likelihood, two typical cases were distinguished. Either the aircraft occupants practically fill the cabin, so that there is little room for movement (e.g., the case of the fighter or sports aircraft pilot), or the cabin space is considerably bigger (e.g., in transports).

The following difficulties are encountered in the first case: unless seat belt and shoulder harness hold occupants firmly in their seats, they will be thrown forward so violently that protruding parts of the cabin equipment can cause serious injury. If the harness is too tight, however, or is not sufficiently elastic, the pilot may be dangerously injured by excessive decelerations. Two questions therefore arise: what is the maximum value reached by the decelerations acting on the human body in such cases? How tight must belts and harnesses be in order to keep the elastic movement of the human body within safe limits at the moment of crash? To find answers to these questions N.A.C.A. undertook a series of experiments with decommissioned jet fighters using dummies instead of pilots, allowing the aircraft to crash at full speed into a low mound of earth. Instruments built into the dummies automatically recorded the course of vertical accelerations and horizontal decelerations. Although the aircraft's speed on crashing was only about 110 m.p.h., the inertia forces arising, especially in the vertical direction, exceeded the maximum that the human body can tolerate. However, efficient, properly fitted harnesses of adequate strength and seats that cushion the crash blow can do much to reduce injury.

The passenger in a commercial transport is restrained only by his seat belt. If the latter breaks or the seat is ripped out of the floor, the passenger becomes virtually a missile, and his chances of survival are slight. One way of ensuring that crash loads do not become too high for the seat, is to make the latter flexible. N.A.C.A. has therefore designed a new passenger seat with elastic pedestal which has sufficient "give" to reduce the peak load applied by the passenger by nearly 75%. Experimental crashes to test the new seat were made at N.A.C.A.'s Lewis Flight Propulsion Laboratory, using remote-controlled aircraft (see left-hand pictures). These proved that passengers in rigidly mounted seats would have been killed in a crash at about 110 m.p.h., whereas passengers in the flexible seats would have survived the accident.

What's in the Air ? *

AVIATION POLITICS

● N.A.T.O. defence talks

Defence Ministers of the fifteen North Atlantic Treaty countries will meet in Paris with N.A.T.O. military authorities an October 10th, to prepare for the regular session of the N.A.T.O. Council of Ministers scheduled for the end of the year.—The Defence Ministers' meeting will have no connection with a possible extraordinary session of the Council of Ministers which may be called just before the Big Four Foreign Ministers' Conference starting in Geneva on October 27th.

● U.S. Air Force 137-wing programme to stay

Despite the Defense Department's economy programme, a 137-wing Air Force is still the goal of U.S. defence planners, Air Force Secretary Donald Quarles told a press conference in Wiesbaden.

● C.A.B. Public Information

The U.S. Civil Aeronautics Board has set up an Office of Congressional Liaison and Public Information under the directorship of Rod Kreger (formerly associated with the Republican National Committee).

SERVICE AVIATION

● U.S. aid for German rearmament

An American delegation led by James H. Smith Jr., U.S. Assistant Secretary of Navy for Air, has been visiting Bonn for talks on the build-up of the new West German Navy.

● Russia offers Austria arms

Russian Ambassador to Vienna Ilychev has informed Austrian Federal Chancellor Raab that the U.S.S.R. is prepared to supply arms and equipment free of charge to the future Austrian forces. The equipment would include aircraft.

● British atomic tests planned for 1956

Two more series of tests of British atomic weapons will take place in Australia next year, the Ministry of Supply announces. As the new proving ground at Maralinga will not be completed until the end of 1955, the new series of tests, beginning in April, will again be held in the Monte Bello Islands. The Scientific Director will be C. A. Adams, Chief of Research at the Atomic Weapons Research Establishment at Aldermaston. The first series will involve about ten explosions of relatively small weapons, such as tactical bombs and guided missile warheads, or perhaps even a "trigger device" for a hydrogen bomb.

● Armament stretch-out in Canada

The Royal Canadian Air Force has ordered Avro Aircraft to cut production of the Avro CF-100 twin-engined all-weather fighter to ten a month. Previously this year production of the type had been reduced from 25 to 15 machines. As a result, Avro's aircraft manufacturing staff was cut from 1,600 to 1,400.—This fresh stretch-out in the arms programme is all the more remarkable in that the CF-100 is still the standard type for Canada's air defence and, when deliveries are complete, will equip 13 R.C.A.F. fighter squadrons.

* Extracts from *Interavia Air Letter*, daily international news digest in English and French. All rights reserved.

An English Electric *Canberra* twin-jet bomber flown by John William Hackett (pilot, left) and Peter Moneypenny (navigator) flew from London to New York and back on August 23rd, 1955 in 14 hours 21 mins 45.3 secs. Average speed 481.52 m.p.h.

AIR TRANSPORTATION

● Both British airline corporations make profit

For the first time in its eight-year history British European Airways made a profit in the 1954-55 business year (to March 1st, 1955), amounting to £63,039 after allowance for taxation and depreciation. This compares with a loss of £1,773,797 the previous year. The B.E.A.report states that the use of larger aircraft—*Viscount* and *Ambassador*—played a great part in reducing operating costs and increasing traffic volume.

The profit earned by British Overseas Airways Corporation fell from £1,065,397 in the 1953-54 business year (to March 31st) to £261,687 in 1954-55, but in view of the difficulties encountered during the year it can be considered as gratifying that any profit was obtained at all. In his Annual Report Board Chairman Sir Miles Thomas recalled that the grounding of the *Comet* had not only robbed the Corporation of one fifth of its transport capacity, but had also involved it in heavy additional expenditure for the procurement of replacement equipment, retraining personnel and reorganizing ground services.

Peter G. Masefield is leaving British European Airways to take over the post of General Manager of Bristol Aircraft Ltd., a new subsidiary of The Bristol Aeroplane Co.

Bell X-2, a research aircraft for extreme altitude and speeds, whose Curtiss-Wright LR-25CW rocket engine works on liquid propellants and is said to develop a thrust of approx. 16,000 lbs.

● Emergency travel insurance

British Overseas Airways Corporation has introduced an emergency travel insurance scheme, in conjunction with the Navigators' and General Insurance Company Ltd., of London, under which persons living overseas can fly by B.O.A.C. to visit a named seriously ill relative or business associate in the United Kingdom or elsewhere. Travel expenses in both directions are paid by the insurance company, and the insured person is covered for all incidental travel expenses, hotel bills etc. for a period of up to 20 days. The policy also carries a personal accident insurance for a maximum of 28 days.

● I.A.T.A.'s "ideal heliport"

The I.A.T.A. working group set up to investigate the operating conditions of helicopters has issued a report defining the "ideal city heliport" based on the experience of airlines operating helicopter services on both sides of the Atlantic. Basic suggestions: area 200 x 400 ft.; control tower; roof installation on two to four-story buildings, at a suitable distance from other tall buildings; most central position possible with regard to traffic conditions (not more than about 300 yards from rail or road centres); maintenance and overhaul facilities to be separate from heliport (e.g., at the nearest airport).

● Airline liquor sales opposed

Opposition by numerous U.S. organizations to the sale of liquor aboard domestic aircraft has prompted the U.S. Air Transport Association to begin work on a draft code of practice for airlines to follow. A 15-point programme is to be discussed by the Air Traffic Conference at its November meeting in San Francisco. Amongst suggestions are refusal to permit intoxicated passengers to enter aircraft, no liquor sales on Sundays or national election days and no sales on coach services.

INDUSTRY

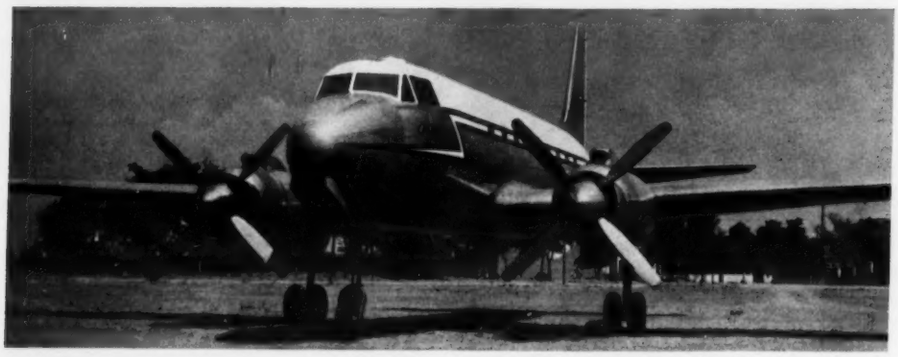
● Peter G. Masefield to go to Bristol

Peter G. Masefield is resigning from his post as Chief Executive of British European Airways, which during his six years of office he has made into a paying concern, to go to The Bristol Aeroplane Co. on November 1st, 1955. The latter firm is to be split into three new subsidiaries on January 1st, 1956—Bristol Aircraft Ltd., Bristol Aero Engines Ltd. and Bristol Cars Ltd.; Masefield will become General Manager of Bristol Aircraft Ltd.

● Death of Robert Blackburn

Robert Blackburn, pioneer of the British aircraft industry and founder of Blackburn & General Aircraft Ltd., died on September 10th, aged 70. He built his first monoplane in 1909 and in 1915 started the firm which he served as Chairman and Joint Managing Director up to his death.

Boeing XB-47D is the designation of a *Stratojet* fitted experimentally with two Wright T-49 turboprops and Curtiss *Turboelectric* four-blade propellers 15ft. in diameter. The B-47 normally has six turbojets.



A first CASA 207 *Azor* twin-engined commercial transport (33/40 passengers; two Bristol *Hercules*) has been completed by the Spanish firm of Construcciones Aeronáuticas S.A.

● C.A.A. to reduce safety supervision

The U.S. Civil Aeronautics Administration is planning to take steps to shift a considerable part of its responsibility for aviation safety to the aircraft industry. A report by C.A.A.'s Office of Aviation Safety contains proposals for the abolition of seven of its air safety activities and the transfer of 21 others to the aircraft industry. C.A.A. would retain 36 safety functions. The report was drafted as a result of President Eisenhower's Budget Message, the relevant point in which was: "With the increasing maturity of civil aviation, the Federal Government should soon be able to reduce substantially its safety promotion and enforcement activities without affecting the present high level of safety." One proposal is that "manufacturers of proven capabilities" should be issued a certificate of airworthiness for the aircraft they manufacture if they certify that they have completed required tests and inspections now undertaken by C.A.A.—C.A.A.'s proposals are not unanimously welcomed by the industry. In some industrial quarters it is felt that C.A.A. should continue to bear responsibility for aircraft safety.

● U.S. aircraft order backlog falls

The backlog of orders on the books of aircraft, engine and propeller manufacturers fell by 1 % during the second quarter of 1955, from $14,100,000,000 at the end of March to $13,900,000,000 on June 30th, the U.S. Commerce Department announces. Military orders accounted for 90 % of airframe orders, 94 % of engine orders and 88 % of propellers orders.

FLYING EQUIPMENT

● *Armstrong Whitworth* announces a project for a five-jet *long-range commercial transport, the Type 167* for 60 first-class or 126 tourist-class passengers. The five jets would be mounted in the rear of the fuselage, behind the passenger cabin.

● *Westland Aircraft* reports development of a new 40-seat helicopter, to be known as the *Westminster*. The single-rotor model, driven by two gas turbines, was designed to meet military requirements and could be used, among other purposes, for the transport of wounded (32 stretchers).—Max. gross weight 33,000 lbs., payload 13,000 lbs., range 310 nautical miles at max. load and a cruising speed of 130 knots.

● The *M.100 Student* light two-seat jet trainer developed by F. G. Miles Ltd. has the following main features: slightly swept shoulder-level wing; cabin with side-by-side seats; air intake for turbojet power plant (one Blackburn *Marboré II* or two Blackburn *Palas 600s*) in cabin roof; tail unit with double end discs.

● More than 200 *Max Holste MH. 1521 Broussard* single-engined multi-purpose aircraft are in production for the French Air Force and Army. The *Broussard* is also built for a number of civil purposes.

● A second prototype of the *SE.210 Caravelle* twin-jet commercial transport built by S.N.C.A. du Sud-Est is 80 % completed and should be ready for flight testing early in 1956.

● The prototype of the *Douglas C-133*, a heavy transport developed for the U.S. Air Force, is in final assembly at Douglas' Long Beach plant and is to be completed by the beginning of December 1955. Test flying is scheduled to begin in February 1956.

● *Lockheed RF-104A* and *TF-104A* are two new versions of the F-100A supersonic fighter: a fighter reconnaissance model and a trainer version, both of which—like later models of the F-104A—will probably be fitted with a General Electric J-79 turbojet (approx. 15,000 lbs. thrust).

Group Captain B. H. Becker has retired after 27 years service with the Royal Air Force and has been appointed Technical Manager, Turbo Propellers, of D. Napier & Son Ltd.

POWER PLANT AND ACCESSORIES

● The *SNECMA ATAR 101G* turbojet has been certificated for a maximum thrust of 9,680 lbs. with reheat.

● Spring 1956 is given as the date for beginning of flight tests for the *Pratt & Whitney J-75* high-performance turbojet (approx. 15,000 lbs.).

● Under the present production programme a batch of twenty *Wright J-67* turbojets is to be built.

● Large-scale experiments with *supersonic propellers* are being carried out by Cornell Aeronautical Laboratory.

● *Link Aviation Inc.* is making an electronic simulator for training guided missile personnel.

● Scientists from Canada's National Research Council have demonstrated a new *afterburner system for jet engines* in which the fuel is injected into the gas stream in front of the turbine. The additional fuel thus also cools the turbine blades, is atomized by the latter and then ignited in the afterburner tail pipe. Extra thrust thus produced is said to be 5 % higher than that in ordinary afterburners, and the cooling of the turbine parts increases the engine's efficiency.

Vickers *Valiant* four-jet V-bomber of the R.A.F.'s No. 138 Squadron about to take off for a demonstration flight at the S.B.A.C. Display, Farnborough. Left, three English Electric *Canberra* jet bombers.

First Impressions

of the 16th S. B. A. C. Display, Farnborough

A remarkably successful week ... was the opinion of *J. J. Parkes*, President of the Society of British Aircraft Constructors and Managing Director of Alvis Ltd. when the 16th S.B.A.C. Display and Exhibition closed on Sunday, September 11th, 1955, after seven full days. This statement does not apply only to the externals and to the number of visitors (300,000) of the entirely successful show. Mr. Parkes was doubtless also thinking of new export orders received to maintain full employment—along with the Government's " Super Priority " programme—during the coming years in the British aircraft industry, which has now reached an employment figure of nearly 250,000. For example, it was announced during the " successful week " that a South American country, Peru, had ordered a substantial number of Hawker *Hunter* interceptors, and Vickers-Armstrongs have booked new firm orders for the *Viscount* turboprop transport: Trans Australia Airlines (2), Burma Airways (3), Hong Kong Airways (2). There is reportedly lively German interest in the *Gnat 2* light-weight supersonic fighter, the *Gnat 1* subsonic prototype of which was seen in flight for the first time at Farnborough, while Handley Page and Scottish Aviation have received numerous enquiries from less developed regions for their *Herald* (35 so far ordered) and *Twin Pioneer* medium and short stage aircraft.

Incidentally, the official name of " Flying Display and Exhibition " can be described as a typical English understatement. There was not one flying display, but seven, carried out in all weather—from bad on Monday and Sunday to good on the other days—at amazing speed and with the utmost precision, according to a programme that remained practically unchanged throughout. On each day around 40 " numbers " were presented in a bare 2½ hours. As for the " exhibition ", with its 60 " static " aircraft and 307 stands for piston and jet engines, rockets, helicopter and fixed-wing models, equipment and accessories of all kinds, structural materials, ground equipment, machine tools, test equipment, computers, etc., it became almost a rival to the British Museum. Once again visitors realized that a single human brain can no longer grasp the multitude of technical details involved in modern aviation. Today, useful work in research, development or production, can be done only by a well-organized team.

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The various " numbers " in the flying display certainly convinced S.B.A.C.'s 6,000 invited guests, tens of thousands of industry and Service personnel and the 240,000 British taxpayers who attended the last three days' demonstrations of the quality of the team-work carried out in the past months and years. As jet fighters are still of paramount importance to the defence of Western Europe under N.A.T.O.'s defensive strategy, it was understandable that the visitor's main interest should have been in the new *English Electric P. 1* single-seat supersonic fighter. Demonstrated by *Wing Commander R. P. Beamont* in subsonic flight only, the P. 1 (Pursuit 1) showed extremely fast rolls and good manœuvrability in slow flight (at approx. 150 knots). It took off and landed at the neighbouring R.A.F. station of Odiham. The P. 1 has a sharply swept wing and tail unit (approx. 60°), is powered by two A.S. *Sapphire* turbojets (of an undisclosed model) one above the other in the fuselage, and is said to be capable of speeds up to Mach 1.5.

The second British supersonic aircraft shown to the public for the first time was the research prototype of the *Fairey Delta 2* (FD. 2), with very thin wing and a single turbojet (R.-R. Avon) with reheat. A structural innovation in this type is the fact that its pointed nose, along with the cockpit, can be drooped by 10°. It is lowered before landing and during taxying to improve the pilot's visibility, but not during take-off. Fairey's Chief Test Pilot *P. Twiss* took the FD. 2 through some very fast rolls and used no fewer than three brake parachutes simultaneously to shorten the landing run.

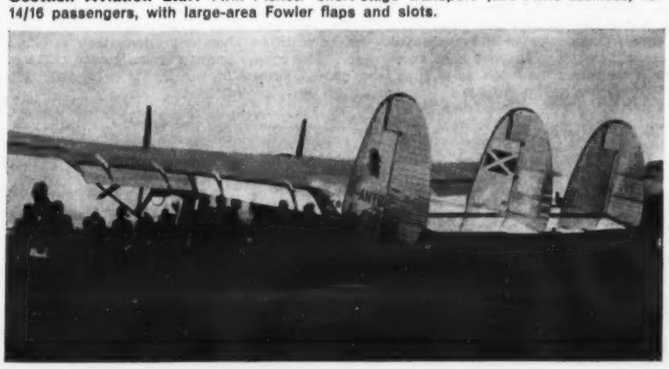
First ground and flight demonstrations were also made by the *Folland Gnat 1*, with *Bristol Orpheus* turbojet held down to a static thrust of 3,285 lbs. : one-piece 45° swept wing of 22 ft. 2 ins. span with inboard ailerons ; low-set hydraulically operated flying tail ; two 30-mm cannon with new-type muzzle gas deflectors, mounted in the air intake lips. — *Squadron Leader E.A. Tennant* demonstrated the *Gnat 1*

The English Electric Co., Ltd.: P. 1 supersonic fighter (two Armstrong Siddeley *Sapphires*).

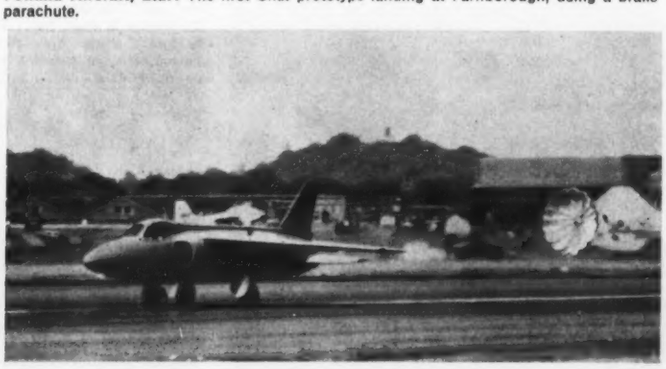
The Fairey Aviation Co., Ltd.: *Delta* 2 supersonic experimental aircraft (one R.-R. *Avon* with reheat).

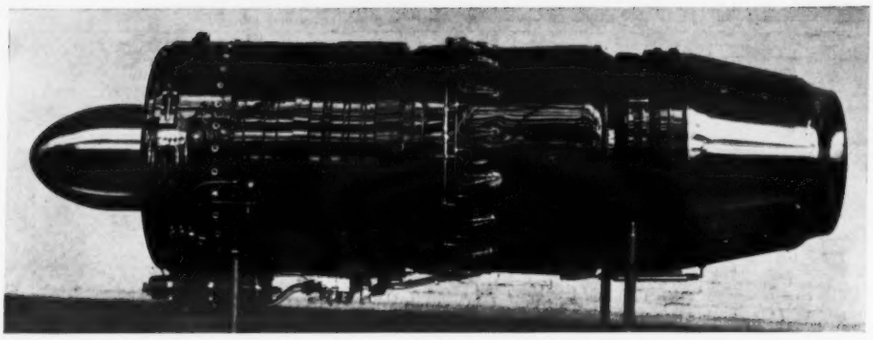
Folland Aircraft, Ltd.: The *Gnat* 1 light-weight fighter (Bristol *Orpheus*) has power-boosted inboard ailerons which both deflect downwards when the undercarriage is lowered.

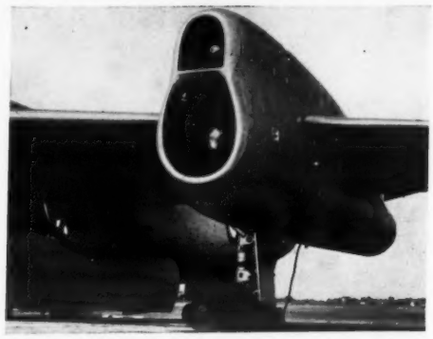
Scottish Aviation Ltd.: *Twin Pioneer* short-stage transport (two Alvis *Leonides*) for 14/16 passengers, with large-area Fowler flaps and slots.



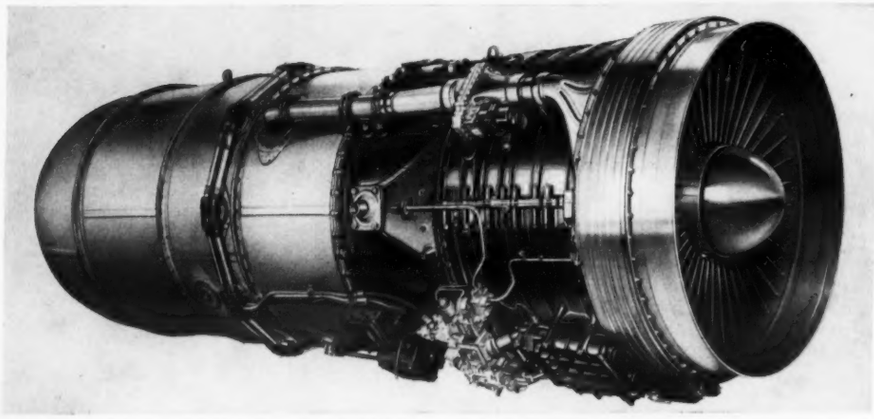
Folland Aircraft, Ltd.: The first *Gnat* prototype landing at Farnborough, using a brake parachute.



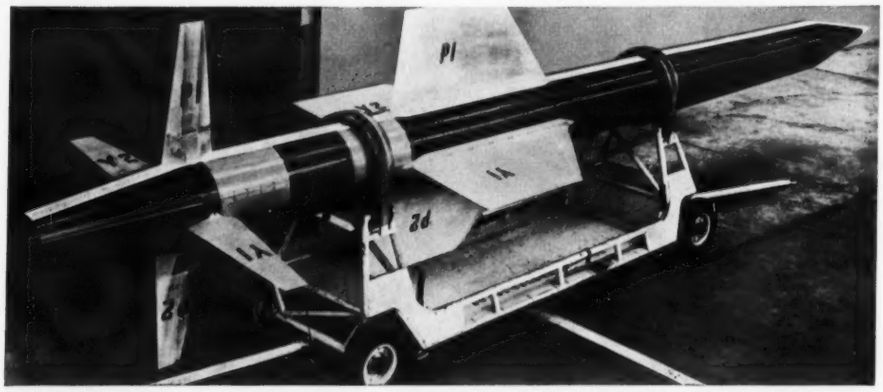




The de Havilland Engine Co., Ltd.: *Gyron* high-power turbojet (16,000 lbs.-plus thrust), which has been under test for some time in a Short *Sperrin* flying test bed (right-hand picture).



Rolls-Royce, Ltd.: *Conway* by-pass engine of 13,000 lbs. static thrust (at present) with very low fuel consumption. A *Conway* has been fitted under the fuselage of an Avro *Ashton* for operational testing.

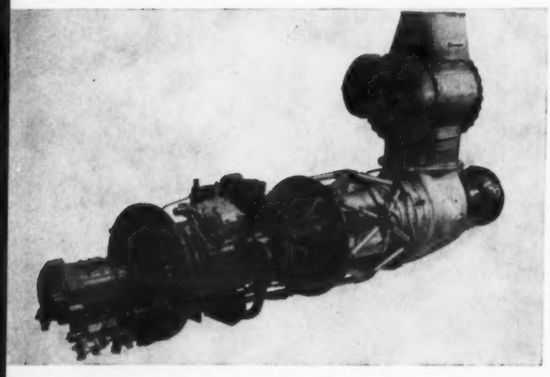


Short Brothers & Harland, Ltd.: A supersonic experimental rocket of undisclosed designation on its trolley.

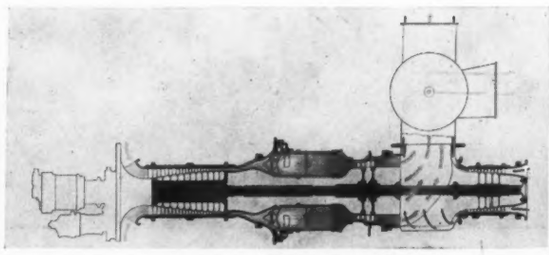
in very fast runs, tight turns and fast rolls; take-off and landing distances (with brake parachute), however, were long. A supersonic version with Bristol afterburner *(Gnat 2)* and a carried-based version *(Sea Gnat)* were also announced.

Among fighter types already known were new versions of the Hawker *Hunter*, including the *Hunter Two-Seater*, an armed reconnaissance model (six cameras in the nose) and the *Mark 6* long-range version with plastic auxiliary fuel tanks and more powerful *Avon*. A fly-past by an R.A.F. fighter formation (four " wings " of sixteen Mk. 1, 2, 4 or 5) proved that the *Hunter* is in service in substantial members. Finally, the *Vickers-Supermarine Swift* was presented in its new role of fast ground attack and armed reconnaissance aircraft (F. R. Mk. 5), equipped with reheat and " saw-tooth " wing leading edge. Last but not least, mention should be made of the Canadian *Avro CF-100 Mk. 4 Canuck* twin-jet all-weather fighter (two Orenda 11s), which *Squadron Leader Jan Zurakowski* showed off in masterly aerobatics.

Among the *bombers* at the show, the *Vickers Valiant* appeared for the first time in formation (12 aircraft from No. 138 Squadron), the *Avro Vulcan* delta bomber (pilot *Wing Commander R. Falk*) made a climbing roll (with a gross weight of over 50 tons), the sky-blue *Handley Page Victor* showed unusually close turns. Other striking performances were the climb of the *Olympus Canberra* (which recently set up a new altitude record of 65,876 ft.) . . . a steep pull-up shortly after take-off . . . and the full aerobatic programme by the *Canberra B. 8* ground attack version and the *Canberra P. R. 9* long-distance reconnaissance model. An aerobatic team of four *Short Seamew* turboprop



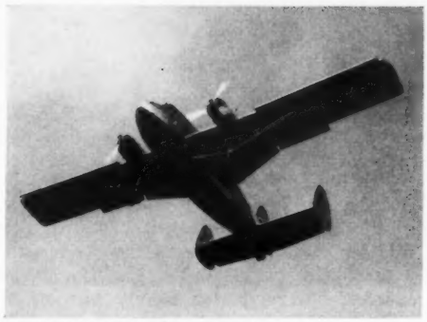
D. Napier & Son, Ltd.: View of the 750 h.p. *Oryx* gas generator from the front (hot side) of the engine. From back to front: starter generator; twelve-stage main axial compressor; five combustion chambers; two-stage turbine; mixing chamber and two-way valve; four-stage auxiliary axial compressor. The engine speed at max. power (750 h.p. at sea level) is 21,900 r.p.m. and it delivers a maximum of 14.4 lbs./sec. gas-air mixture at 400° C.



D. Napier & Son, Ltd.: Gas flow diagram of the *Oryx* turbo gas generator. The hot gases, expanded in the turbine on the left of the engine, are mixed in a " spiral chamber " with cold compressed air from the secondary compressor (on right of engine). A two-way valve (top) then passes the mixture either out into the open or—in the position shown—to the pressure nozzles of a helicopter rotor.

The Fairey Aviation Co., Ltd.: Ultra-light helicopter.

Westland Aircraft, Ltd.: *Widgeon.*



Scottish Aviation: *Twin Pioneer.*

Handley Page, Ltd.: 36/44-seat *Herald* commercial transport (four Alvis *Leonides Majors*); picture on right.

The Fairey Aviation Co., Ltd.: The experimental *Jet Gyrodyne* powered by an Alvis *Leonides* with *Merlin* supercharger ; two pusher propellers plus combustion nozzles at the rotor blade tips.

anti-submarine aircraft all taking off together gave convincing proof of this type's excellent manoeuvrability both in flight and on the ground. After taxying to take-off point (with wings folded), a short take-off in formation and a fly-past, the three forward aircraft in the formation made fast climbing rolls, while the fourth completed a loop.

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The new commercial transports at the Display can be dealt with more briefly here, since four of them (Handley Page *Herald*, de Havilland *Comet 4*, Vickers *Viscount 800* projects and Aviation Traders *Accountant*) are described elsewhere in this issue. However, reference should also be made to two more types, the *New Elizabethan* and the *Twin Pioneer*.

The *New Elizabethan*, one of B.E.A.'s 44-seat *Ambassadors* fitted by *D. Napier & Son Ltd.* with two 3,000 e.h.p. *Eland* turboprops, flew past the stands with one engine cut and then accelerated this engine to full power within three seconds. After touchdown the propellers were immediately switched to full reverse thrust and used for braking. The *New Elizabethan* is about 65 knots faster than *Centaurus Elizabethan* now in service and should be able to carry roughly 1,100 lbs. more payload. B.E.A. plan to put it into service next year, initially on cargo services.

Scottish Aviation's Twin Pioneer twin-engined 14/16-seat short-stage transport (colloquially described as the " Double Scotch ") impressed spectators by its exceptionally short take-off and landing distances (less than 100 yards), which are attributable to the large-area (strutted) wing with big slots and Fowler flaps. Engines : 550 h.p. Alvis *Leonides ;* span 76 ft. 6 ins., gross weight 15,400 lbs, speed range 43 to 157 knots. — The aircraft will be a serious rival to the helicopter, particularly in inter-city operations.

*

In the *rotary-wing* field, the Display offered three new types : the *Fairey Jet Gyrodyne* combined helicopter (experimental forerunner of the 40/50-seat *Rotodyne*), the *Fairey light helicopter* (no further designation at present) and the *Westland Widgeon*. All flew in " good form ", though the *Jet Gyrodyne* was also striking for the noise it produced.

Some details of the engines shown in the Exhibition or in flying test-beds will be found in the accompanying pictures and the table in No. 9, 1955 (p. 689). Lack of space precludes further discussion on the 16th S.B.A.C. Display in this issue. The November issue will therefore contain a more detailed description, with an illustrated account of the flying displays and details of the most important products of the *British equipment industry*.

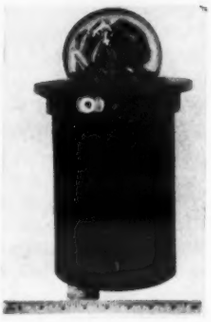
Westland Aircraft, Ltd.: The five-seat *Widgeon* helicopter (Alvis *Leonides*) has been developed from the four-seat Sikorsky S-51.

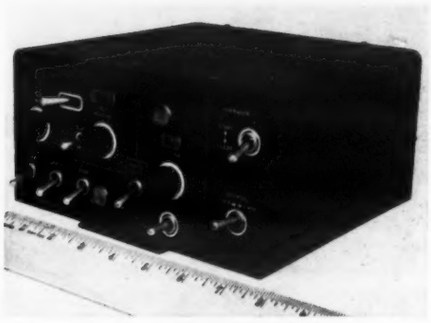
A. V. Roe & Co., Ltd.: *Shackleton M. R. 3* long-range sea reconnaissance aircraft with nose-wheel undercarriage (four R.-R. *Griffons*).

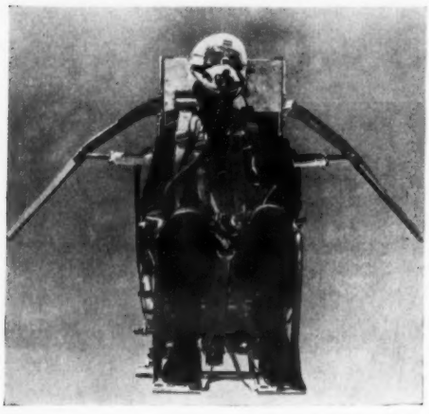
Equipment Round-Up

● Automatic aircraft sextant

Kollsman Instrument Corp., of Elmhurst, New York, is producing an automatic sextant for astronomical navigation, which tracks the sun or other celestial bodies by means of a photo-electric telescope and automatically indicates the altitude measured. The equipment consists of three components : the sextant tracking device, with photo-sensitive telescope (left), the indicator with control panel (right), and the amplifier. — Operation is simple. The navigator merely sets on the control panel the estimated position of the selected celestial body, whereupon the sextant's telescope sweeps from right to left and searches an area of sky 7° wide and 5° high until it finds the star to be tracked. The system then starts automatic tracking.





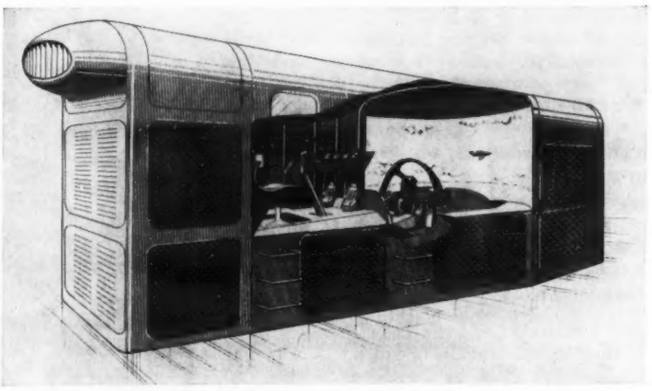


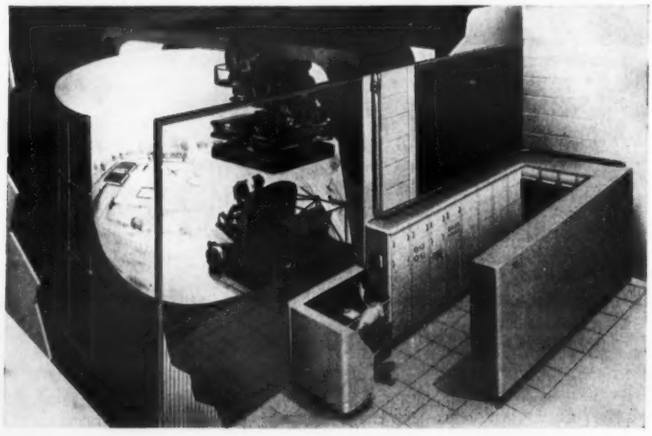
● Ejection seat for supersonic aircraft

Douglas Aircraft Company has developed, under contract to the U.S. Air Force, a new type of ejection seat for the X-3 research aircraft, with stabilizing fins. It is ejected downwards from the fuselage and descends without excessive buffeting. — The acceleration at which the seat would have to be ejected upwards at 1,800 m.p.h.—in order to clear the tail—is beyond the maximum endurable by the human organism. A system of downward ejection was therefore developed. As for the buffeting after ejection, ground tests with high-speed sleds have shown that the human body can more easily withstand the forces of ejection if it is seated upright in relation to the direction of the forces. The problem was also complicated by the need to stabilize the seat through three speed ranges : supersonic, transonic and subsonic. Wind tunnel tests proved that stabilizing fins which spread out on either side of the seat after ejection best solve this problem. The weight of the seat was also increased, to reduce the effect of air forces, by attaching ejection rails, complete oxygen system and other components to the seat instead of to the airframe.

● Gunnery trainer

A combat gunnery training device for fighter pilots has been developed by *Société d'Applications des Machines Motrices (SAMM)* for the French authorities. The electronic trainer consists of a fully equipped cockpit for the student (on right in picture) and a control desk with instruments for the instructor. A 5-ft screen in a horse-shoe round the student's seat reproduces a panoramic picture of firing targets, and a loudspeaker provides realistic imitations of engine and gunnery noises. A counter records the number of " rounds " fired and the number of " hits ", and each " hit " is indicated by the target lighting up in red. From his desk the instructor can control the target on the student's screen by means of control column and rudder bar, as if he were piloting the aircraft under pursuit.



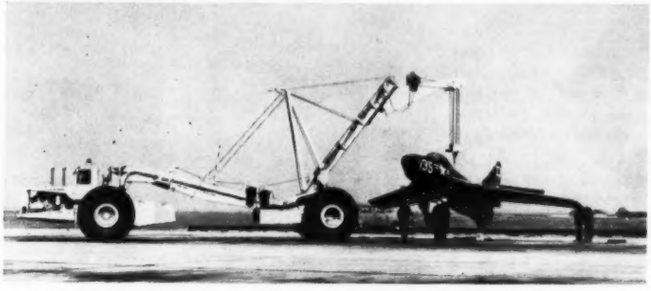


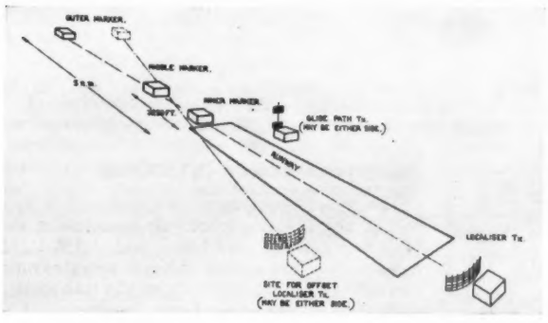
● Helicopter simulator

The series of flight simulators already in existence has now been supplemented by a helicopter simulator which, according to *Bell Aircraft Corporation*, its makers, works so realistically that the student can even get air-sick. — Known as the 2-HF-2, it has been developed for the Office of Naval Research (Special Devices Center) and is shortly to be put into use at the Navy's flight school at Pensacola, Florida. — The flight simulator consists in essentials of a pilot's compartment (which simulates the cockpit of a Bell 47), an electronic computer and a panoramic projector. The latter moves a panoramic picture through the student's field of vision at a speed, direction and attitude corresponding to the flight condition, with trees, houses, fences and other obstructions coming into the foreground in turn. For this purpose a moving landscape is suspended above the pilot's seat and projected on to a hemispherical screen. Behind the student's seat is a control desk for the instructor, who sets simulated flight conditions : fuselage vibrations, engine and rotor noise, gusts, control forces, even engine troubles.

● Aircraft handling crane

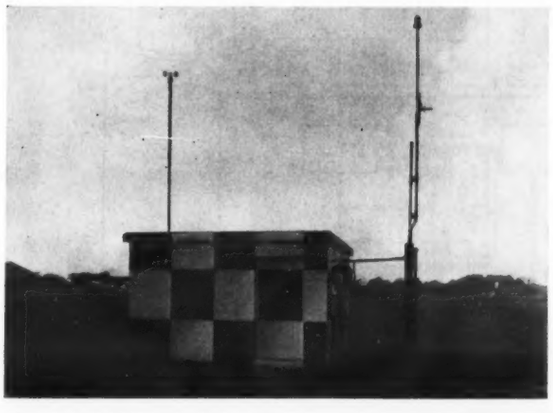
This mobile crane with a lifting capacity of 80,000 lbs. (designation *MB-1*) is in service at a number of U.S. Navy air bases and is used primarily for lifting aircraft for regular checking of the hydraulic undercarriage. The 325 h.p. engine of the 48-ton vehicle can also supply electric current via a 120-volt generator for emergency lighting systems, building sites, hand tools etc. The crane was developed by *LeTourneau-Westinghouse Company* of Peoria, Illinois, for the Navy Bureau of Aeronautics and has the following lifting capacity : 80,000 lbs, up to 9 ft. 6 ins. behind the centre line of the crane wheels, 70,000 lbs. at 17 ft., 63,000 lbs. at 23 ft. and 41,000 lbs. at 28 ft. The crane hook is normally operated by electric remote control from the cab at the rear of the vehicle, though for specially delicate tasks the remote control box, which is attached to a long cable, can be moved so that the crane can be controlled from the ground near the hook.





Localizer transmitter with parabolic aerial

Glide Path transmitter



● New instrument landing system

The Telecommunications Division of *Pye Limited*, Cambridge, has developed, under contract to the Royal Air Force, an automatic Instrument Landing System, which can also be supplied in a civil version meeting I.C.A.O. requirements. Ground equipment consists of duplicate VHF Localizer transmitters with parabolic aerial, duplicate UHF Glide Path transmitters and three VHF markers, all remote-controlled from a control desk (normally in the airport control tower). Automatic correction and warning equipment (monitor units) provides constant control of the signals emitted. Errors in the approach path and Glide Path plane, such as may occasionally occur through phase and amplitude variations in the control lobes which are modulated at 90 c/s and 150 c/s, are constantly recorded by two measuring aerials and compensated by the correcting equipment coupled to the transmitter in question. If major failures occur, the monitors for approach course and glide path automatically switch over to the standby equipment. For example in the case of the Localizer transmitter switch-over is made as soon as there is : 1) a course shift of more than 1/3 of a degree : 2) a change in beam width of $\pm$ 20 % ; 3) a fall in transmitter power greater than 50 % of normal.

A special feature of the Pye system is the Localizer transmitter's parabolic aerial, whose directional beam increases the transmitter's useful range to 50 miles. This type of aerial system also reduces course distortions and thus minimizes siting problems and improves accuracy of indications in the aircraft. An accurate approach can therefore be made by using an automatic pilot with an approach coupler. To ensure reliability in operation long-life valves are used throughout, and there are no moving parts. For example, all transmitter units are electronically modulated.

When there is no room to erect the parabolic aerial beyond the runway, it can also be set up to one side (see drawing). The slightly angled approach course line is then adjusted so that the aircraft intersects the runway centre line at an altitude and distance sufficient to allow its course to be corrected visually.

TECHNICAL DATA :

Localizer transmitter (centre picture) : Frequency 108.1-112 mc/s ; Modulation frequencies 90 c/s and 150 c/s ; Range approx. 50 miles ; Identification tone 1,020 c/s ; Speech frequency 350-4,000 c/s ; Power consumption 2 kW ; Output power 50 watts.

Glide Path transmitter : Frequency 328.6-335.4 mc/s ; Modulation frequencies 90 c/s and 150 c/s ; Range approx. 20 miles ; Power consumption approx. 2 kW ; Output power 20 watts.

Marker beacons. Frequency 75 mc/s ; modulation frequencies 400 c/s (outer), 1,300 c/s (middle) and 3,000 c/s (inner) ; output power 3 watts.

The TACAN UHF Radio Navigation System

The recent declassification of TACAN (Tactical Air Navigation System ; cf *Interavia* No. 9, 1955, p. 705) has made it possible for the American manufacturers *(Federal Telecommunications Laboratories,* a division of *International Telephone & Telegraph Corporation)* and their British licence-holders *(Standard Telephones & Cables Ltd.)* to publish operational and technical details of this new UHF radio navigation system and to display the most important ground and airborne equipment at Farnborough early in September. The following brief description is based on releases from both firms.

*

The TACAN system is an integrated bearing and distance radio navigation aid operating in the frequency range from 962 to 1,213 megacycles, and is capable of providing navigation information to a line-of-sight distance of 200 nautical miles. The system can provide a bearing accuracy of better than $\pm$ 1° and a distance accuracy of $\pm$ 600 ft., plus 0.15% of the distance measured, when the antenna of the ground equipment is sited for optimum results. Optimum siting requires a tower, to assure that the radiated energy from the ground equipment clears all nearby objects (radiation pattern see *fig. 2*).

A TACAN ground station (e.g., the British Standard STURN. 3 version ; cf. *fig. 3*) comprises a double cabinet approx. 77 ins. high (and 66 ins. wide) for the electronic equipment, in particular the 10 kW Klystron (Z. 211/IE), a single cabinet of the same height for the air conditioning system, an aerial control cabinet 51 ins. high, and the aerial assembly (vertical central radiating array, two rotating fibreglass cylinders with vertical parasites, a plastic radome and a motor) 79 ins. high and 48 ins. in diameter.

The TACAN airborne set (e.g., Standard STARN. 21 ; cf. *figs. 4 and 5*) comprises an interrogator/receiver (73 lbs.), a control unit (1.25 lbs.), a coupling unit (7.5 lbs.) and an indicator (1.5 lbs.). Up to 100 aircraft can receive distance information simultaneously from the same ground station, but the number able to obtain azimuth information is unlimited. Distance from the ground beacon (in nautical miles) is shown as a figure in the indicator window, while the pointer shows on a compass rose two values of interest to the pilot : the blunt end indicates the azimuth of the aircraft position in relation to the ground station, the pointed end the true map course for homing to the beacon. The structure of an interrogator/receiver (76 tubes, current requirement approx. 500 VA) is illustrated in *fig. 6*.

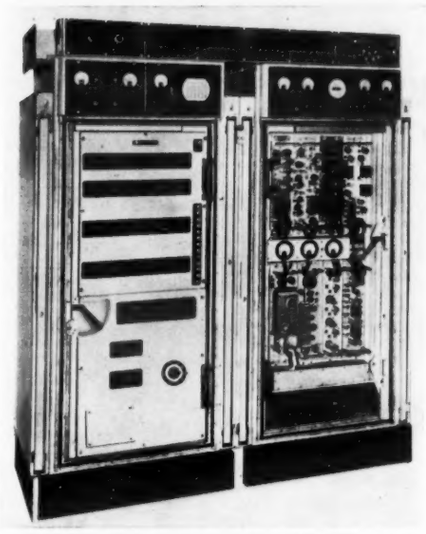


Fig. 1: Double cabinet (with four retractable doors) for the electronic equipment of the TACAN ground beacon. The left-hand cabinet contains (from top to bottom): remote control connectors and metering instruments; test gear; decoding unit (behind rectangular plate). The right-hand cabinet houses the control unit and video circuits, and—*behind* the hinged front panel—the 10 kW Z.211/1E amplifier klystron for the transmitter.

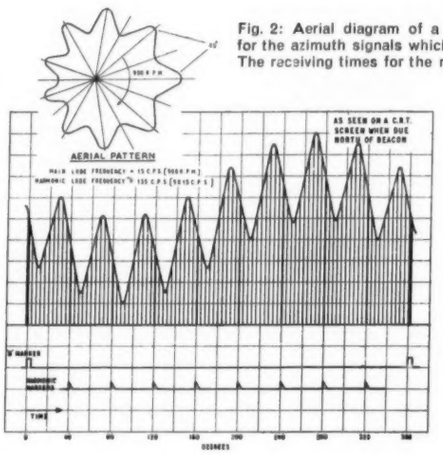


Fig. 2: Aerial diagram of a TACAN ground beacon and amplitude modulation envelope for the azimuth signals which would appear on a cathode ray tube due north of the beacon. The receiving times for the main signal and the eight 40° auxiliary signals are also shown.

The ground beacon (STURN.3)

The ground equipment can transmit on any one of the 126 one-megacycle channels in the frequency ranges 962-1,024 and 1,151-1,213 megacycles. The ground receiver operates on a frequency 63 megacycles above the transmitter frequency in the lower range (channels 1-63), and 63 megacycles below the transmitter frequency in the higher range (channels 64-126) :

Channel Number	Ground Transmitting frequency	Airborne interrogation frequency
1- 63	962-1,024 mc/s	1,025-1,087 mc/s
64-126	1,151-1,213 mc/s	1,088-1,150 mc/s

Fig 3: Structural diagram (left) and block diagram of a TACAN ground beacon.

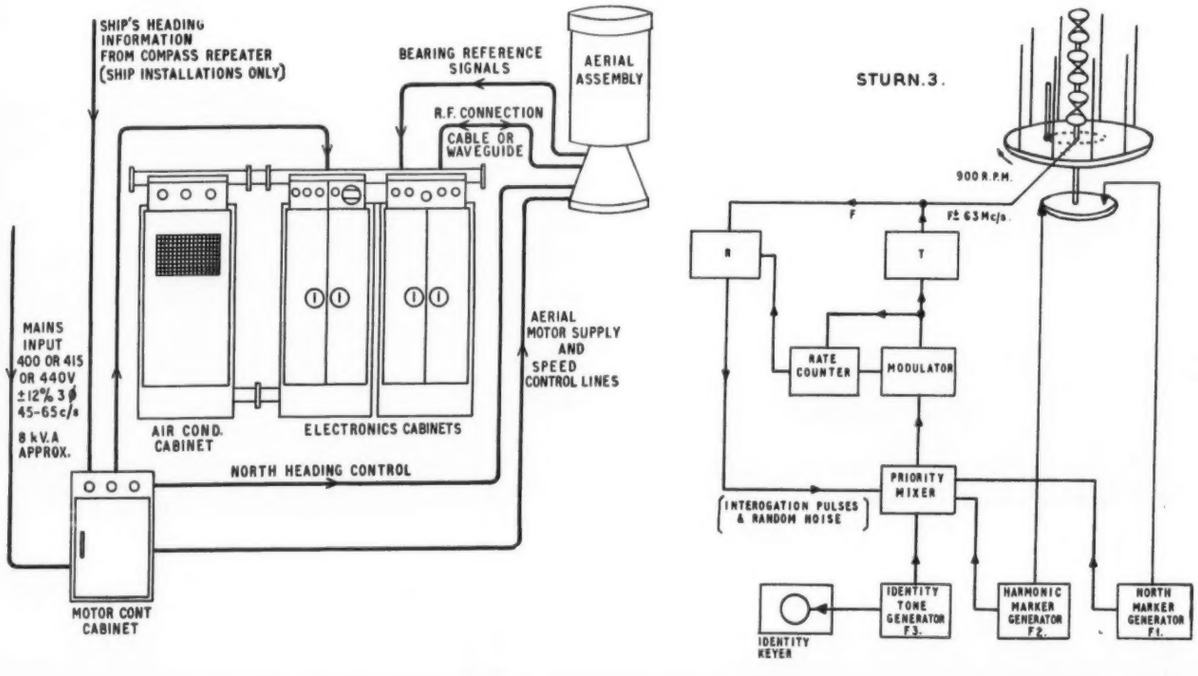


Fig. 4: Cockpit equipment of a TACAN airborne set (Standard T. & C.; STARN.21): top, the *control unit* with selection knobs for 126 channels and channel window (with channel 46 set); underneath, the combined *indicator* for azimuth, true homing course and distance from beacon (left) and the *coupling unit* (right).

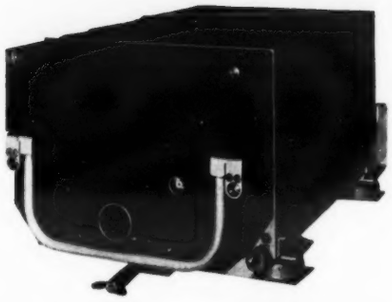


Fig. 5: Interrogator/receiver of the STARN.21 airborne set with mounting tray and rubber shock absorbers: weight 73 lbs.; dimensions 10×7.5×18.5 ins.; current consumption 460 VA of 115 Volt a.c. at approx. 400 c/s plus 20 W of 28 Volt d.c.

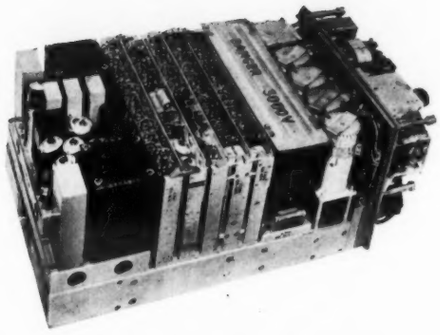


Fig. 6: The inside of a TACAN transmitter/receiver unit. Leftto right: power unit, video decoder, azimuth gate, azimuth control, range gate, range control, modulator (marked "Danger"), R.F. unit, front panel. The main chassis underneath contains an I.F. amplifier, a 42 mc/s oscillator and a frequency multiplier.

The composite azimuth and distance reply signal transmitted by the ground beacon consists of 3.2 microseconds pulses transmitted in pairs with a pulse spacing of 12 microseconds. A total of 3,600 pulse pairs are transmitted per second ; 2,700 of these pulse pairs are random in time and include synchronized replies to distance interrogations from aircraft. The remaining 900 pulse pairs consist of : 12 pairs of pulses spaced 30 microseconds (known as the main reference pulse group and triggered when the single parasitic element passes through north) and eight groups of six pulse pairs (known as auxiliary pulse reference group) spaced 24 microseconds transmitted 15 times per second as the antenna rotates, thus corresponding to an antenna rotation of 40°.

To provide azimuth information the pulsed radio frequency output of the transmitter is amplitude modulated by the antenna system (cf. *fig. 2*). The antenna consists of a vertically polarized stationary array around which rotate, in a clockwise direction, two sets of parasitic elements contained in cylinders. The antenna rotates at 15 rps. The inner cylinder contains one parasitic element and modulates the pulse amplitude at the receiver at 15 cycles per second. The other cylinder contains nine parasitic elements and superimposes a 135 cycles per second modulation on the fundamental 15 cycles per second modulated signal. The bearing of an aircraft with respect to the surface beacon is determined at the aircraft by comparing the time of occurrence of the reference pulse groups with the phase of the amplitude modulation produced by the ground antenna rotation.

The random pulse-pairs (2,700 pairs/sec.) are triggered by noise when no signal is received by the ground receiver, but if a pulse-pair with 12 microseconds spacing is received, the ground transmitter replies to it. Thus the distance of an aircraft from the beacon is determined in the aircraft by measuring the time interval between an interrogation and the reply.

The airborne set (STARN.21)

The airborne receiver operates in the same frequency range as the ground transmitter ; that is, from 962 to 1,024, and from 1,151 to 1,213 megacycles. The airborne interrogator transmits on channels from 1,025-1,150 megacycles per second. The receiver frequency is 63 megacycles below the transmitting frequency in channels 1-63 and 63 megacycles above the transmitter frequency in channels 64 to 126. The equipment transmits and receives pairs of 3.5 microseconds pulses spaced 12 microseconds apart. The peak power of the transmitted pulses is 1-1.5 kilowatts ; and the receiver sensitivity is 110 db below one watt. One megacycle selectivity in the airborne receiver is achieved by means of a Ferris discriminator (cf. *fig. 7*, top right).

Operation of the receiver circuitry after the decoder (cf. *fig. 7*) can be divided into azimuth and range. Each part has two conditions of operation—search and track.

Fig. 7 : Block diagram of a TACAN airborne set (Standard STARN.21).

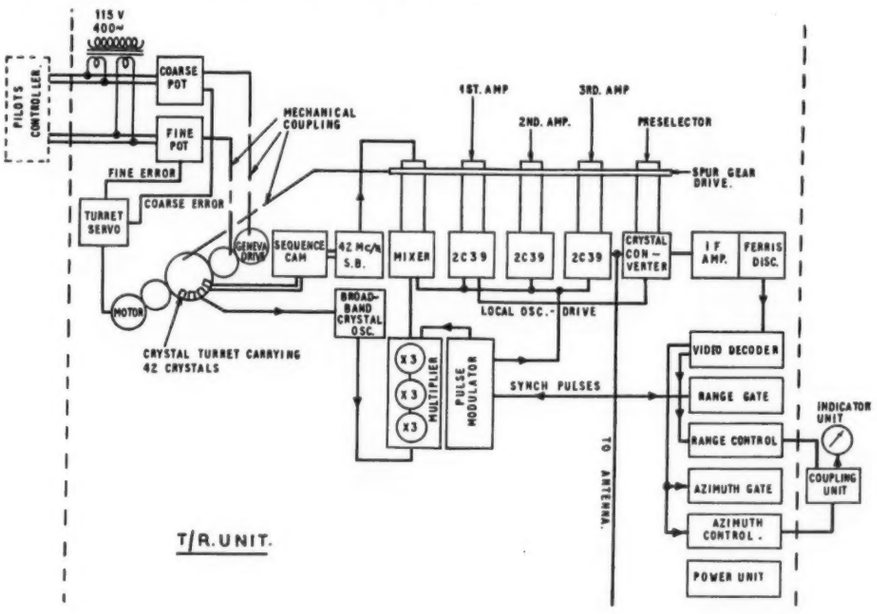
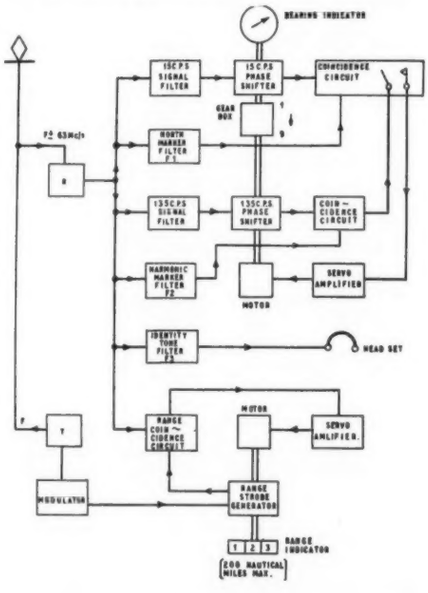


Fig. 8 : Circuit diagram for azimuth measuring (top) and distance measuring (bottom) in the STARN.21 airborne set.



As already stated, azimuth information is derived by comparing the time of occurrence of the reference pulse groups with the phase of the amplitude modulation produced by the rotation of the antenna. The 15 cycles per second modulation and the north reference group, which occurs 15 times per second, are used to establish the 40 degree sector in which the aircraft is located, while the 135 modulation and the auxiliary reference groups serve as a vernier to locate the aircraft accurately within the previously determined 40 degree sector.

The basic operation of the circuits (cf. *fig. 8*) is the same at both frequencies ; a gate formed from the sinusoidal modulation signal is used to open the pulse channel for a short time during each cycle, and the time of occurrence of this gate is varied by changing the phase of the sinusoidal signal in a rotary phase shifter. The two phase shifters are geared together in such a way that the 135 cycles per second shifter turns nine times while the 15 cycles per second shifter is turning once. This geared assembly is motor driven and is continuously rotated during search. When the north reference group occurs at the time of the 15 cycles per second gate, the output of the pulse channel closes a relay which puts the equipment into the track condition. In this condition the motor is connected to a servo system actuated by the output of the auxiliary reference group channel and operates so that the 135 cycles per second gate is kept centred around the pulse from the auxiliary reference group. The azimuthal angle is obtained from the position of the gear train when the pulse is centred in the gate.

The distance-measuring circuits depend on a 4,044 cycles per second crystal-controlled oscillator. The transmitter is triggered by a pulse generated from the output of this oscillator, and a number of cycles later another pulse is used to open a range gate. The number of cycles between the time of the transmitted pulse and the opening of the range gate is determined by the setting of a motor-driven potentiometer ; geared to this potentiometer is a phase shifter which permits the time delay between the transmitted pulse and range gate to be continuously variable. During the search condition, the motor increases this time delay until a reply pulse from the ground transmitter falls within the range gate. The search-to-track relay is then actuated to connect the motor to a servo system centring the reply pulse in the gate. The angular position of the ganged potentiometer and phase shifter indicates the range of the aircraft from the ground station. The repetition rate of the transmitted pulses during search is approximately 150 pulses per second, and during track, approximately 30 pulses per second.

It requires about 20 seconds for the airborne receiver to complete a search cycle of 200 miles in range and 360° in azimuth. However, it takes only one second to establish a correct reading after the pulses start to fall in the gates. If, during the tracking operation, the signal is lost abruptly, the airborne receiver will start a new search cycle.

The Editors and Publishers of INTERAVIA have pleasure in announcing that **Herman F. M. Schreiber,** Captain-Pilot in the Swiss Air Force, has taken over the editorship of **Interavia ABC,** *Directory of World Aviation.*

Born at Arth-Goldau, Switzerland, on November 11th, 1909, Schreiber began his career as a glider pilot (winning a Gold Medal at the 1936 Olympic Games for the first glider crossing of the Alps). He has wide foreign experience and has held the following posts in Switzerland : technical assistant at the Swiss Federal Air Office and glider expert of the Swiss Aero Club ; head of the Technical Service and pilot with Alpar Airport Management Company, Berne ; technical adviser to the Swiss Pool of Aviation Insurers.

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4.

Highlights from the History of Swiss Aviation

1945 Swissair resumes services at the close of the war.

1946 The Swissair fleet is increased to 18 aircraft by the purchase of four DC-4s.

1948 Opening of regular trans-Atlantic services to New York.

1949 The four Convair Liner 240s ordered by Swissair arrive in Switzerland.

1951 Two DC-6B long-range aircraft are put into service.

1952 The International Air Transport Association holds its General Meeting in Geneva, and Swissair is responsible for preparation and organization.

1953 With the arrival of three more DC-6Bs, Swissair's fleet of modern long-range aircraft is increased to six of this type.

1954 Swissair opens its South American service and introduces a DC-4 freight service between Switzerland and New York.

1955 Swissair is the first European airline to order four Douglas DC-7C aircraft.

SWISSAIR

EUROPE USA SOUTH AMERICA NEAR EAST

ASIA

EUROPE

AFRICA

U. S. A.

AUSTRIA — EGYPT — FRANCE — GERMANY
GREECE — IRAN — IRELAND — ISRAEL — SPAIN
SWITZERLAND — TUNISIA — TURKEY
UNITED STATES
connected with the whole Italian network
by **DOUGLAS DC-6B**
and **CONVAIR LINER**

LAI

LINEE AEREE ITALIANE
in Switzerland : SWISSAIR

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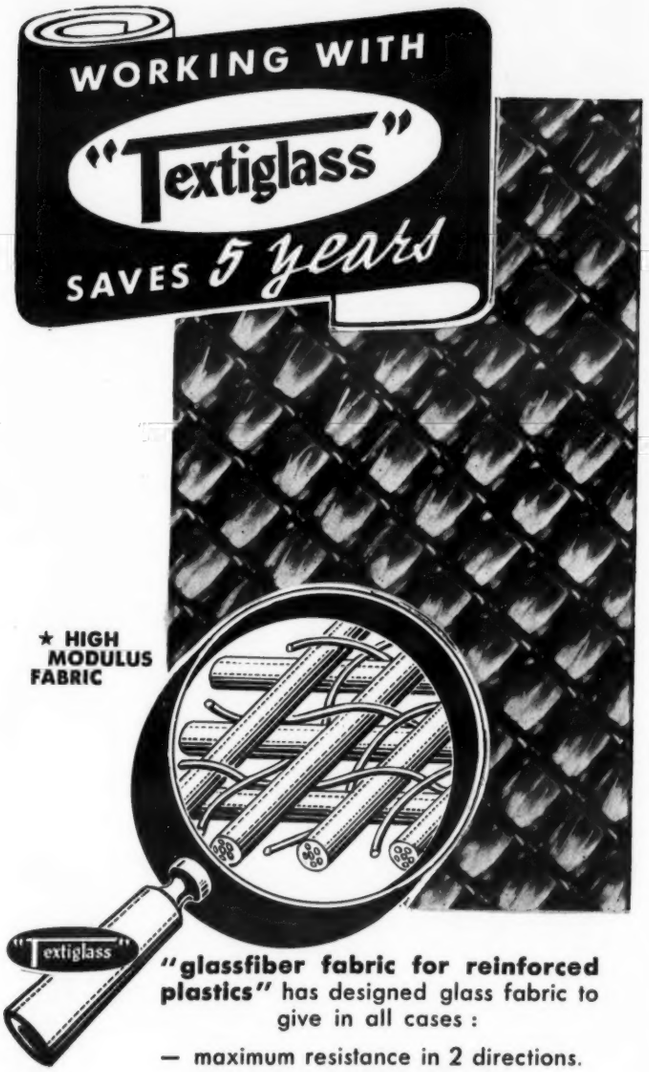

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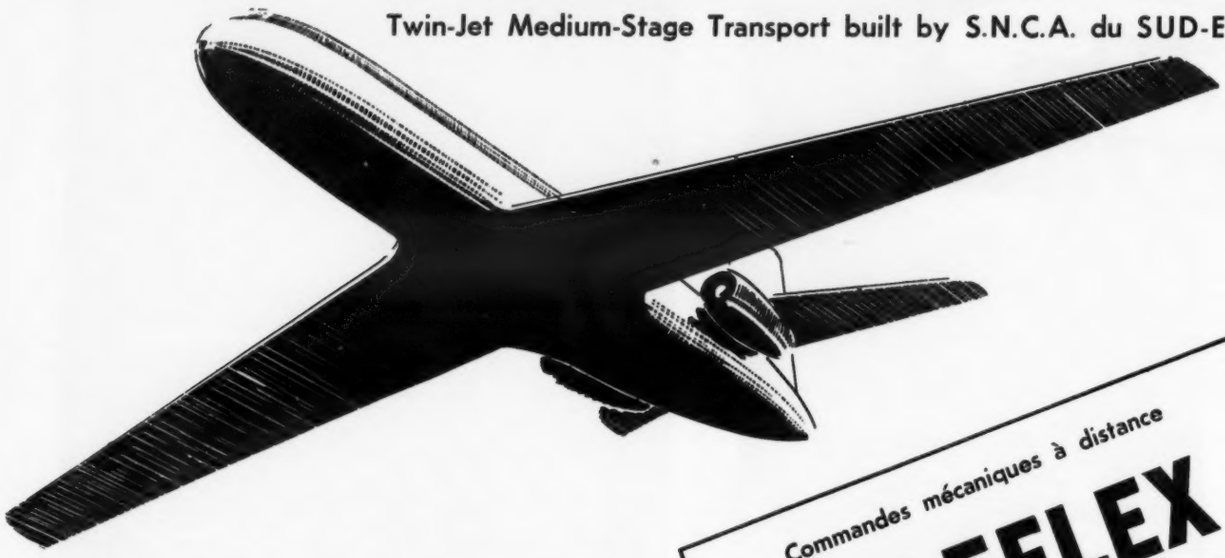

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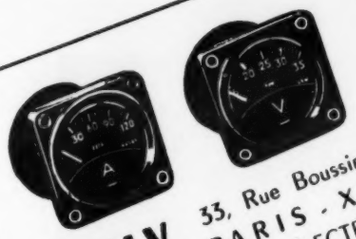

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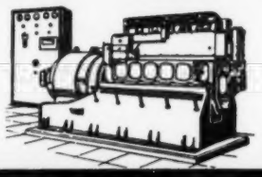

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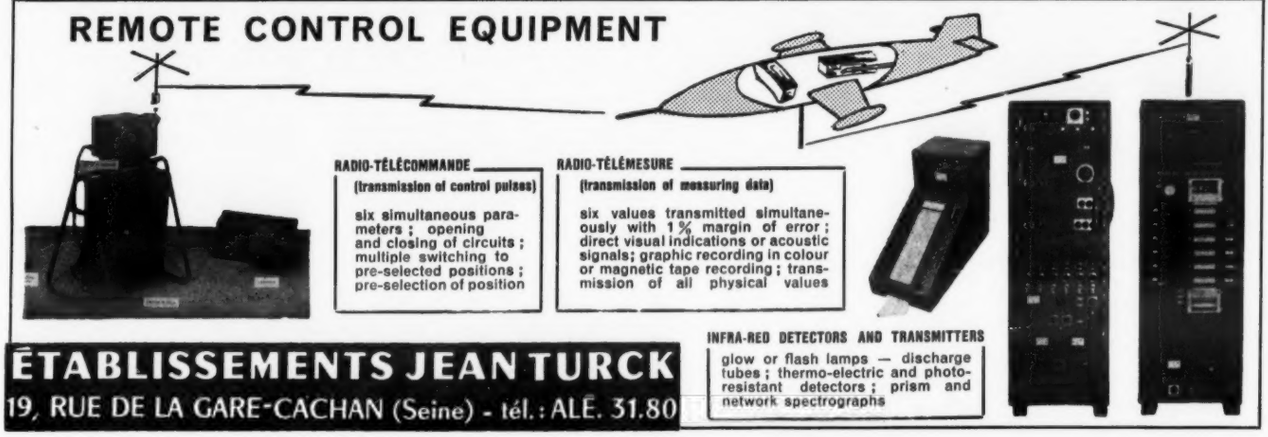

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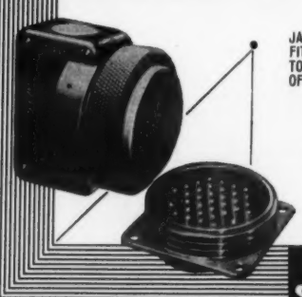

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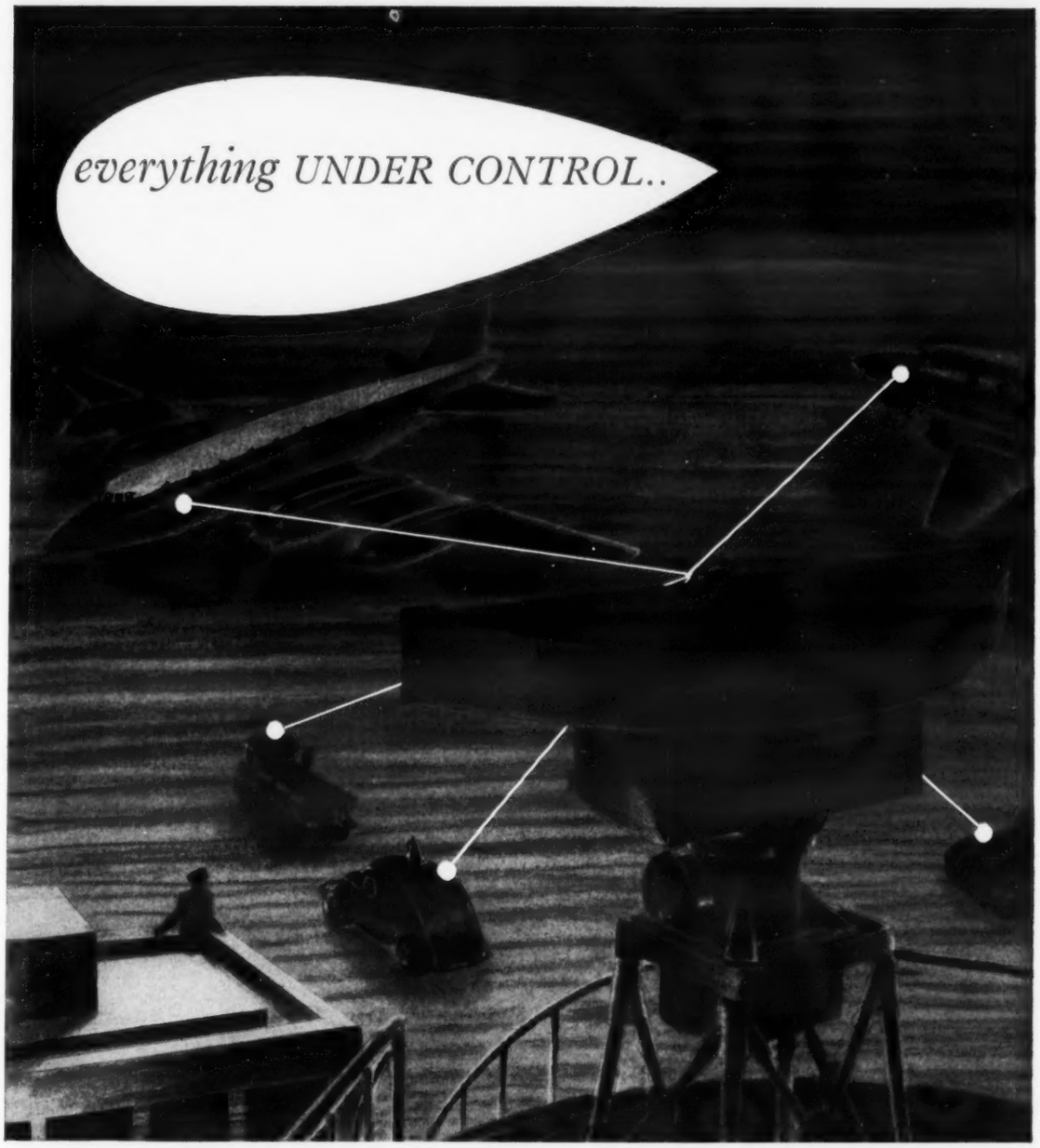

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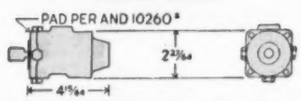

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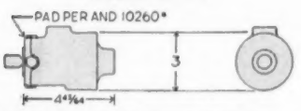

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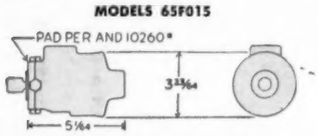

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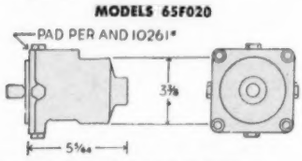

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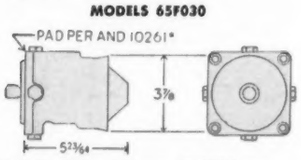

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